Examining the effectiveness of reflective practice, self-regulatory and cognitive strategies to enhance sport-specific risk and pain management during ultra-endurance performance.


Thesis submitted by:


Britta Maria Sorensen


For the award of Doctor of Philosophy

Fasth School of Sport Exercise and Applied Sciences.

St Mary's University, United Kingdom.


31st March 2025

# Declaration of Originality

**DECLARATION OF ORIGINALITY**

Students are reminded that the work that they submit for assessment must be their own. Please read the following statements and sign and date at the bottom of this form to show that you have complied:

1. This thesis and the work to which it refers are the results of your own efforts. Any ideas, data or text resulting from the work of others (whether published or unpublished) are fully identified as such within the work and attributed to the originator in the text, bibliography or footnotes.

2. This thesis has not been submitted in whole or in part for any other academic degree or professional qualification at this or any other institution.

3. Any chapters that describe the outcomes of joint research should be clearly identified as such with a statement inserted as a footnote on the first page and contributors named. Significant data, images or text resulting from the input of other researchers should be identified as such and attributed to the persons concerned by means of a footnote within the chapter.

4. It is usual to acknowledge the help and guidance of others who have assisted you during your research and preparation of your thesis. Such acknowledgements do not replace or obviate the need for individual attribution as discussed in points 1 and 3.

5. The University reserves the right to submit electronic versions of your draft documents for assessment of plagiarism using electronic detection software such as 'turnitin'. In addition, whether or not drafts have been so assessed, the University reserves the right to require an electronic version of the final document (as submitted) for assessment.

SIGNED:...........................................................................................
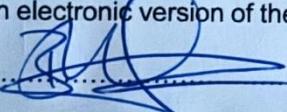
PRINT NAME:... BM SØRENSEN .............................................................

DATE:... 31/3/25 ...........................

St Mary's University, London

Britta Maria Sorensen

For the award of Doctor of Philosophy

Examining the effectiveness of reflective practice, self-regulatory and cognitive strategies to enhance sport-specific risk and pain management during ultra-endurance performance.

## Abstract

Pain is an accepted and normalised aspect of participation in ultra-endurance sports, influenced by biological, psychological, and social factors. Despite their proven achievements and growing participation rates, female ultra-athletes remain an understudied population. This thesis addresses the research gap by examining female ultra-athletes' pain experiences and coping strategies through a biopsychosocial lens. Using a multi-phase mixed methods design, three complementary studies investigate how female ultra-athletes perceive, evaluate and cope with pain across different sports, capturing these experiences through retrospective, longitudinal and real-time temporal dimensions to reflect the multidimensional and subjective nature of pain.

Study 1 used Interpretative Phenomenological Analysis to explore the retrospective lived pain experiences of 13 female ultra-athletes. The ability to push through pain was influenced by personal backgrounds (e.g., trauma, life situation) and the inextricable link between psychological wellbeing and physical health, where athletes' drive to maintain mental equilibrium through training often created tension with physiological recovery needs. Study 2 longitudinally examined pain, mood, pain coping, and recovery of three professional ultra-triathletes over 64 weeks, revealing how professional identity shaped pain interpretation and management strategies. Pain experiences fluctuated dramatically based on numerous biopsychosocial factors, with major injury events creating new perceptual benchmarks that "reset" athletes' pain scales. The COVID-19 lockdown revealed how pain tolerance was intrinsically tied to professional purpose rather than being an inherent trait, with athletes conceptualising pain as actively chosen when serving meaningful competitive goals. Study 3 analysed real-time pain experiences of five ultra-endurance athletes during their chosen ultra-sports events. Think-aloud verbalisations illuminated a variety of sport-specific pain experiences and coping strategies (e.g., chunking distance during running and counting pedal cadence up steep mountain passes), as well as the biopsychosocial (gastrointestinal issues, anxiety, mood, mom guilt, and support crew) and environmental factors (weather, terrain, different country) that influenced their pain perceptions and coping strategies.

The integrated findings established how self-reflective experiential learning had developed a tacit bodily awareness for how to interpret their race and injury-related pain. The years of accumulated ultra-endurance pain experience had facilitated athletes' planning with future expected pain experiences through development of self-regulatory coping strategies. Comprehensive support networks proved to be invaluable to assist with both immediate pain management and long-term athlete wellbeing. Practical implications include the need for interdisciplinary support networks, especially for athletes whose drive to push through pain is linked to maintaining mental wellbeing, potentially leading to overtraining and injury. Recommendations include structured pain education, development of personalised self-regulatory coping strategies, and facilitation of social support to maintain balanced physical and psychological wellbeing for female ultra-endurance athletes.

## Acknowledgements

**Thesis Publications and Conference Proceedings**

**Conference Proceedings**

1. Pushing Boundaries: Women in Sport and Exercise Conference (WISEAN), St Mary's University, Twickenham, June 11–12, 2019. Poster presentation: Female ultra-endurance athletes: An exploration of their pain experiences

2. SAHPS Festival of Research Jul 7, 2019, London: 10-minute oral presentation on Female ultra-endurance athletes: An exploration of their pain experiences

3. Getting Back on Their Feet: Women in Sport and Exercise Academic Network (WISEAN) Virtual Conference, Sept 7–8, 2020:

   a. Tuesday 8th September. A longitudinal case-study approach to professional female ultra-triathletes' pain management

   b. Tuesday 8th September. (Lightening talk – 5 mins) How is the elite cycling world changing for the French female cyclist? A cultural and comparative snapshot of progress so far

4. Faculty of Sport, Allied Health & Performance (SAHPS) Festival of Research, Tuesday 7th July – Thursday 9th July 2020. Tuesday 7th July. Theme Title: Pain; Nutrition & Genetics; Space Travel! Talk 2: Female ultra-endurance athletes: An exploration of their pain experiences.

5. Faculty of Sport, Allied Health & Performance (SAHPS) Festival of Research 28th June – 1st July 2021, via Zoom. Monday 28th June 2021. Theme 1: Female Athletes and Exercisers: Talk 3: Britta Maria Sorensen: A case study approach for monitoring the real-time race pain and coping experiences of the female ultra-athlete

6. FEPSAC Conference, Padua, Italy. July 2022. Study 1 presented as an oral presentation and was also the Chair for this session.

7. BPS Conference, Swansea, UK. In December 2022. An oral presentation at the DSEP conference based on Study 3 as a critical reflection of using the Think-aloud protocol within a field setting.

**Publications**

**Women in Sport and Exercise Conference Abstracts**

1. Sorensen, B. M., Meijen, C., & Winter, S. (2020). Female ultra-endurance athletes: An exploration of their pain experiences**,** *Women in Sport and Physical Activity Journal, 28*(1), 55-65. https://doi.org/10.1123/wspaj.2020-0011

2. a. Sorensen, B. M., Meijen, C., & Winter, S. (2021). A longitudinal case-study approach to professional female ultra-triathletes' pain management. *Women in Sport and Physical Activity Journal, 29*(1), 74-75.

    https://doi.org/10.1123/wspaj.2020-0076

    b. Sorensen, B. M. (2021). How Is the Elite Cycling World Changing for the French Female Cyclist? A Cultural and Comparative Snapshot of Progress So Far, *Women in Sport and Physical Activity Journal, 29*(1), 74-75.

    https://doi.org/10.1123/wspaj.2020-0076

3. Sorensen, B. M., Meijen, C., Winter, S. & Martin, E. (2025). 'Pushing Myself Beyond the Limits': Exploring the Lived Pain Experiences of Female Ultra-Endurance Athletes Through a Biopsychosocial Lens. (In review for peer-review journal publication)

# Table of Contents

**Revised 87, 142**-word count (excluding references and appendices).

<h1 style="text-align: center">List of Tables</h1>

**Chapter 3 Study 1**

**Chapter 4 Study 2**

**Chapter 5 Study 3**

## List of Figures

## List of Abbreviations

ANOVA - Analysis of Variance

AVD - Avoidance (SIP subscale)

BOD - Body Awareness (SIP subscale)

BPS - Biopsychosocial

BRUMS - Brunel Mood Scale

CAT - Catastrophising (SIP subscale)

COG - Cognitive (SIP subscale)

COP - Direct Coping (SIP subscale)

DMP - Dualistic Model of Passion

DOMS - Delayed Onset Muscle Soreness

EAMC - Exercise-Associated Muscle Cramp

EIP - Exercise-Induced Pain

GB - Great Britain

GPS - Global Positioning System

GWS - General Wellbeing Subscale

IASP - International Association for the Study of Pain

IM - Ironman (triathlon)

IOC - International Olympic Committee

IPA - Interpretative Phenomenological Analysis

IS - Injury Subscale

MPQ-SF - McGill Pain Questionnaire Short Form

NRS - Numerical Rating Scale

PPI - Present Pain Intensity

QUAL - Qualitative

QUANT/quant- Quantitative

RESTQ-Sport - Recovery-Stress Questionnaire for Athletes

SIJ - Sacroiliac Joint

SIP - Sport Inventory for Pain

STM - Short-Term Memory

TCR - Total Coping Response

TENS - Transcutaneous Electrical Nerve Stimulation

TMD - Total Mood Disturbance

TR - Total Recovery

TS - Total Stress

UE - Ultra-Endurance

VAS - Visual Analogue Scale

XTri - Extreme Triathlon

**Chapter One: Introduction**

The human capacity for endurance has long fascinated researchers, practitioners, and the public alike. As athletes push the boundaries of what seems physically possible, understanding the interplay between physical capabilities and psychological resilience becomes increasingly crucial. This thesis examines this intersection through the lens of female ultra-endurance athletes, investigating how they interpret, manage, and overcome the extreme challenges of their sport, with particular focus on their experiences of pain and coping strategies.

In contemporary endurance research, ultra-endurance is commonly defined as any performance duration of six hours or longer (Zaryski & Smith, 2005). However, this temporal criterion alone inadequately captures the multidimensional challenges these events present to participants. These events encompass a diverse range of activities including ultra-running, ultra-cycling, ultra-triathlon, and adventure racing, all involving continuous, dynamic, and whole-body exercise tasks performed over long distances or duration (McCormick et al., 2015). These activities take place across varied settings, terrains, and environmental conditions, creating multidimensional demands that extend far beyond simple duration. Variations in course design and environment fundamentally influence the biomechanical, physiological, nutritional, sociological, and psychological requirements athletes encounter (Berger et al., 2024; Best et al, 2018; Judelson et al, 2015b; McNarry et al., 2020; Roebuck et al., 2018; Schutz et al., 2012; Thorpe & Clark, 2020), as well as the strategies both athletes and their support crews must employ to succeed in the challenge to finish.

Among these multidimensional challenges, pain emerges as a particularly significant performance factor, distinct from but related to other unpleasant sensations including fatigue, discomfort, and effort perception that athletes must simultaneously navigate. Researchers show that pain systematically increases throughout ultra-events, alongside decreased

cognitive function, increased gastrointestinal distress, and reduced neuromuscular capacity (Berger et al., 2024). Indeed, these ultra-endurance sport activities are characterised by the normalisation of pain and discomfort as integral components of participation, with athletes demonstrating remarkable willingness and ability to endure considerable suffering (Allen-Collinson et al., 2018; McNarry et al., 2021). Researchers conducting a recent review found that ultra-endurance runners demonstrate higher tolerance and lower pain-related anxiety compared with non-runners (Berger et al., 2024). However, Berger et al. explicitly avoided gender-specific analysis, indicating that female ultra-athletes' pain experiences remain an understudied area requiring dedicated investigation. This gap is particularly significant given that pain is fundamentally biopsychosocial in nature, with biological, psychological, and social factors interacting to create unique experiences for female athletes (Bernardes et al., 2008; Hainline et al., 2017; Karos et al., 2024; Mogil et al., 2024). Understanding how female[1] ultra-endurance athletes navigate pain requires examining not only their physiological responses but also the gendered social contexts in which their athletic identities and pain experiences are constructed.

## 1.1 The Evolution and History of Ultra-Endurance Sport

To understand why female ultra-endurance athletes' pain experiences, remain understudied despite growing participation, it is essential to examine the historical trajectory of women's inclusion in endurance sport. The evolution from systematic exclusion to growing acceptance provides crucial context for understanding why research representation continues

---

[1] Sex is defined as a biological marker used to categorise individuals into male or female based on physical characteristics such as chromosomes, hormones, and genitalia. Gender, by contrast, refers to the socially and culturally constructed meanings of being and acting as a man or woman, shaped by societal norms, roles, and expectations (Bernardes et al., 2008). For this study, participants were recruited based on the biological definition of female sex. Throughout this thesis, I use "women" when discussing the social and cultural dimensions of gender in sport, recognising that gender identity and expression are socially constructed rather than solely biologically determined (Bernardes, 2008). I use "female" when referring to biological sex characteristics, research methodologies, or when citing research that uses this terminology. Following Coen et al. (2024), I apply this terminology flexibly based on context—for example, using "female" in methodological sections when describing participant selection criteria, while using "women" when presenting participants lived experiences. In quotations, I preserve participants' own language choices, maintaining their use of terms such as "women," "female," or other self-referential language as spoken. This approach aligns with research emphasising how sporting experiences are shaped by gendered social processes rather than essential biological categories.

to lag behind participation patterns, and why female athletes' capabilities have only recently begun to receive scientific attention.

At the dawn of modern organised sports, women faced systematic exclusion from endurance events based on Victorian-era beliefs about women's physical capabilities and appropriate social roles. This exclusion was most notably epitomised by institutionalised sexist views within the International Olympic Committee (IOC), as illustrated by its founder Pierre de Coubertin's (1912) explicit vision for the Olympic Games:

> In our view, this feminine semi-Olympiad is impractical, uninteresting, ungainly, and, I do not hesitate to add, improper. It is not in keeping with my concept of the Olympic Games, in which I believe that we have tried, and must continue to try, to put the following expression into practice: the solemn and periodic exaltation of male athleticism, based on internationalism, by means of fairness, in an artistic setting, with the applause of women as a reward. (p. 713)

This vision, positioning women as spectators rewarding male athletic achievement rather than athletes, reflected broader cultural assumptions about women's physical fragility and the perceived dangers of strenuous exertion to female reproductive capacity. These prejudiced and institutionalised views (Polley, 2014) created systematic barriers that would take decades to dismantle, with implications extending far beyond competitive opportunities to encompass scientific investigation, medical understanding, and cultural perceptions of female athletic capability.

Early resistance to this exclusion emerged through determined advocacy. In 1917, Alice Milliat proclaimed that "Women's sport has its place in social life in the same way as men's sport" (Fondation Alice Milliat, n.d.), directly challenging the IOC's restrictions on women's competitive participation. Milliat's advocacy included organising separate women's competitions that demonstrated female athletic capabilities and created pressure for inclusion

within established sporting structures. Her efforts contributed to the milestone inclusion of women in the 1928 Olympics, though this represented only partial progress—many endurance events remained closed to female participants for decades to come, with marathon distance particularly resistant to women's participation.

The marathon distance became a crucial battleground for challenging assumptions about women's capacity to endure pain and discomfort during prolonged exertion (Burfoot, 2014). When Roberta 'Bobbi' Gibb completed the Boston Marathon in 1966, her achievement directly confronted prevailing medical beliefs that women were physiologically incapable of managing the pain associated with marathon distances. Completing the race in 3:21:40 and surpassing two-thirds of the male participants, her performance provided empirical evidence contradicting exclusionary assumptions. However, her achievement went unrecognised until 1996, reflecting the persistence of sexist attitudes that dismissed female athletic accomplishments even when they occurred in public view. As Gibb later reflected, "I knew I had to run Boston [marathon] to show what women could do" (Burfoot, 2014, p. 44), articulating her explicit intention to challenge physiological assumptions through embodied demonstration.

Similarly, Kathrine Switzer's 1967 Boston Marathon participation highlighted the social dimensions of women's endurance participation, with race officials' attempts to physically remove her from the course demonstrating the intensity of resistance to female inclusion in endurance events. These attempts to forcibly exclude Switzer occurred despite her official registration, revealing how cultural expectations about appropriate feminine behaviour influenced not only perceptions of women's relationship with physical discomfort but also institutional willingness to permit women's participation regardless of capability. As Switzer noted, "It took the Olympic marathon to show the entire world how physical and

powerful women could be" (Burfoot, 2014, p. 65), identifying the crucial role of high-profile competitive inclusion in shifting cultural perceptions.

These pioneering efforts culminated in the inclusion of the women's marathon in the 1984 Olympics, supported by Dr. David Martin's research demonstrating that physiological stress responses and associated pain experiences during marathon running affected women no differently than men when accounting for training status (Burfoot, 2014). This scientific legitimation established a foundation for investigating gender-specific aspects of pain management in endurance contexts, though the transition from demonstration of capability to systematic scientific investigation would prove lengthy.

However, as Capranica et al.'s (2013) analysis demonstrates, the relationship between equity and equality in sporting contexts extends beyond simple access to competition. Their international expert consensus reveals that until the cultural environment is equitable, scientific discussion related to physiological differences using methods that examine progression in male and female world-record performances is limited. Social and cultural inequities systematically influence both participation opportunities and research methodologies, creating reduced opportunity and sociopolitical factors that influence full female participation across a range of sports around the world. This framework guides researchers to reveal how historical exclusion continues to influence present-day existing research gaps—even as women's participation has grown exponentially, research approaches continue to reflect historical biases that positioned male physiology as the normative standard against which female experiences were measured or, more commonly, excluded entirely.

The historical exclusion of women from pain research specifically compounds these broader sporting exclusion patterns. As Keogh et al. (2024) and Mogil et al. (2024) document, women were systematically excluded from pain research studies for decades due to concerns about menstrual cycle impacts and potential pregnancy, creating what researchers

explicitly term biased literature that fails to capture female-specific pain mechanisms and experiences at both human and basic science levels. This legacy means that even as women gained access to endurance sporting participation, the scientific frameworks for understanding their pain experiences remained grounded in male-derived models, creating knowledge gaps that persist into current ultra-endurance contexts.

This historical trajectory from exclusion to inclusion demonstrates how cultural acceptance of female athletic participation often precedes scientific understanding of women's specific experiences and capabilities. The battles fought by pioneers like Gibb and Switzer established women's right to participate in endurance events, but the scientific investigation of how women's experiences might differ from men's—incorporating biological, psychological, and social dimensions—has lagged substantially behind participation growth. Understanding this historical context illuminates why present female ultra-endurance participation occurs within research landscapes that systematically underrepresent women's experiences. Furthermore, why dedicated investigation of female-specific pain experiences represents not merely scientific interest, but correction of longstanding knowledge deficits rooted in historical exclusion patterns.

**1.2 Contemporary Growth and Ultra-Endurance as Cultural Phenomenon**

Ultra-endurance sports have experienced unprecedented growth over recent decades, transforming from niche activities into a global phenomenon with significant cultural and economic implications. This expansion has been particularly dramatic for female participation, yet this growth has not been matched by corresponding advances in scientific understanding of women's experiences.

*1.2.1 Exponential Participation Growth*

Analysis of global ultra-endurance data reveals remarkable expansion across multiple decades. Participation in ultra-endurance sport has grown exponentially from fewer than 20

events annually pre-1969 to 7,465 worldwide events in 2019, with individual participation increasing from 16,585 participants in 1980 to 432,000 in 2019 (Berger et al., 2024). When examined through a narrower temporal lens, this growth appears even more dramatic: from fewer than 1,000 events with 89,597 finishes in 2005 to more than 7,000 events with 682,156 finishes in 2019. The exponential trajectory reflects ultra-endurance sport's evolution from marginal pursuit to mainstream athletic endeavour with substantial global participation (Berger et al., 2024; Harford, 2025).

Female participation has grown particularly significantly within this expansion. The ratio of male to female participants has declined dramatically from 22.2:1 in 1980 to just 3.4:1 in 2019 (Berger et al., 2024), representing nearly an eightfold improvement in female representation over four decades. Women now constitute approximately 25% of ultra-endurance participants globally, reflecting broader societal changes in gender equity and challenging traditional assumptions about women's endurance capabilities. The growth trajectory is particularly significant given that women are generally more sensitive to pain, experience greater vulnerability to chronic pain conditions, and report higher pain across the lifespan compared to men (Keogh et al., 2024). Thus, suggesting that increasing female participation occurs despite distinct pain-related challenges that remain largely unexplored in research contexts.

### 1.2.2 Ultra-Endurance as Cultural Phenomenon

Beyond participation numbers, understanding the cultural significance of ultra-endurance requires examining the diversity of contexts in which these events occur. Ultra-endurance events encompass remarkable diversity in both format and context, ranging from 50-kilometre trail runs to multi-day stage races exceeding 1,000 kilometres. These competitions span multiple disciplines including ultra-running, ultra-cycling, ultra-triathlon, and adventure racing, each presenting distinct physical and psychological demands. Events

take place across varied environmental conditions—from extreme desert heat in events like the Marathon des Sables to high-altitude mountain passages in ultra-trail competitions—creating diverse pain-inducing challenges that extend far beyond the fundamental requirement of extended duration (Armstrong et al., 2012; Creer et al., 2024; Holt et al., 2014). This diversity in contexts and demands necessitates comprehensive understanding of how athletes develop and implement pain management strategies across different ultra-endurance environments.

The cultural significance of ultra-endurance extends well beyond sporting achievement to encompass multiple interconnected dimensions. Commercially, the sport has developed into a substantial industry with specialised equipment markets exceeding £2 billion globally, supporting innovations in GPS tracking technology, nutrition science, and performance analytics (Harford, 2025). The adventure tourism dimension has created destination races that attract international participants, generating significant economic activity in host regions while positioning ultra-endurance events as transformative experiences rather than merely competitive challenges. These commercial and technological developments have made ultra-endurance more accessible to broader populations, contributing to participation growth while simultaneously creating new forms of expertise and specialisation (Harford, 2025).

Ultra-endurance sport physical cultures valorise endurance and stoicism, establishing unique social spaces where traditional gender norms are simultaneously challenged and reinforced (Allen-Collinson & Jackman, 2022). These sporting communities develop value systems around pain tolerance, suffering, and persistence that shape participants' identities and experiences in ways that extend beyond individual athletic achievement. As Karos et al. (2024) demonstrate, cultural contexts create varying expectations about gender-appropriate pain behaviour, with different societies holding distinct beliefs about acceptable pain

expression for men and women. For female ultra-athletes, navigating these cultural expectations while pursuing sporting goals that demand extreme pain tolerance creates complexity requiring investigation beyond traditional sporting research paradigms.

A recent analysis on ultra-endurance sport's role revealed it as the new escape from modern life pressures, with participants seeking transformative experiences that provide meaning beyond traditional sporting achievement (Harford, 2025). This cultural shift positions ultra-endurance events as vehicles for personal transformation and psychological well-being, particularly relevant for understanding why increasing numbers of women are drawn to these extreme challenges despite their intensive physical demands. Such participation shifts reflect broader societal changes in sporting culture and gender relations while creating new contexts for examining female athletic experiences (Liston et al., 2021).

The intersection of these cultural dimensions—commercial development, technological advancement, tourism economics, social community formation, and transformative meaning-making—establishes ultra-endurance as rapidly growing global phenomenon with significance extending far beyond sport (Harford, 2025). The extreme selectivity of these events, particularly affecting women at the longest distances, creates urgent need for understanding women's specific experiences within these multidimensional cultural contexts. Women now represent substantial proportions of ultra-endurance participants yet continue to face institutionalised gender ideologies that may create barriers to recognition and support within these sporting communities (Karos et al., 2024). Understanding how female ultra-athletes navigate pain within these complex cultural contexts requires attention to both the sporting demands they face and the broader social environments in which their athletic identities are constructed.

**1.3 Female Performance and Persistent Research Underrepresentation**

*1.3.1 Performance Convergence: Challenging Traditional Assumptions*

Traditional sporting paradigms have long established clear performance advantages for male athletes across most competitive contexts. The American College of Sports Medicine's consensus statement confirms that adult men are typically stronger, more powerful, and faster than women of similar age and training status, with performance gaps of 10%–30% depending on the requirements of the event (Hunter et al., 2023). These differences, grounded in biological factors including VO$_2$max capacity and muscle mass disparities, have historically justified separate competitive categories and shaped assumptions about gender-based athletic limitations. Traditional sports, designed predominantly around brief, high-intensity efforts, consistently demonstrate these performance gaps across sprint distances, strength events, and power-based activities (Hunter et al., 2023).

However, ultra-endurance contexts systematically challenge these established patterns, demonstrating progressive performance gap reduction as event duration extends beyond traditional endurance boundaries. This convergence phenomenon has been documented across multiple disciplines and investigated through increasingly sophisticated analytical approaches. Hallam and Amorim's (2022) analysis of 1,881,070 runners across 38,860 trail running races confirmed that the gap between men and women shrinks when trail running distance increases, establishing this pattern across an unprecedented dataset spanning diverse competitive contexts. Waldvogel et al.'s (2019) examination of 339,425 ultra-marathon records revealed systematic gap reduction from 9.13% in 50-mile races to 4.41% in 100-mile races. Subsequently, demonstrating a 52% reduction that challenges conventional assumptions about gender-based performance limitations while potentially creating unique opportunities for female athletes to challenge traditional gender hierarchies through embodied sporting achievement.

This performance convergence extends across multiple ultra-endurance disciplines, suggesting fundamental rather than sport-specific mechanisms. Baumgartner et al.'s (2020)

analysis demonstrated complete gap elimination in ultra-cycling at extreme distances, with no significant sex differences observed in 400-mile and 500-mile races compared to clear male advantages in shorter ultra-distances. Their examination of over 12,000 race results revealed performance ratios dropping from 1.16 in 100-mile events to 1.04 in 500-mile events, indicating that female physiological advantages become increasingly relevant as event duration extends beyond conventional boundaries. Sitko et al.'s (2025) comprehensive meta-analysis of 15 studies across 20 different ultra-endurance events found an overall performance gap of 22%—significantly smaller than the 10-12% gaps typically observed in traditional endurance sports. Crucially, this meta-analysis revealed large heterogeneity across studies and disciplines, indicating that some ultra-endurance contexts provide particularly favourable conditions for female performance convergence. Additionally, Tiller et al. (2021) documented performance gaps as low as 4% in some ultra-distance competitions, approaching parity levels rarely observed in traditional sporting contexts.

The mechanisms underlying this systematic gap reduction involve physiological advantages that become increasingly important as event duration extends into ultra-endurance territories. As Berger et al. (2024) acknowledge that females exhibit numerous phenotypes that would be expected to confer an advantage in ultra-endurance competition (e.g., greater fatigue resistance, greater substrate efficiency and lower energetic demands). These advantages include superior fat oxidation rates, enhanced pain tolerance capabilities, and more efficient thermoregulation—factors that become progressively more relevant as events extend beyond 6–8 hours where aerobic metabolism and metabolic efficiency predominate over anaerobic power and sprint capacity. The physiological profile that creates disadvantages in brief, high-intensity efforts may provide systematic advantages in contexts demanding sustained performance over extended durations..

The potential for ultra-endurance sports to disrupt traditional gender hierarchies extends beyond physiological performance metrics to encompass fundamental reconceptualisation of athletic bodies and capabilities. Hanold's (2010) Foucauldian analysis of female ultrarunners found that participation in ultrarunning led to critical awareness of the normative running body through direct embodied experience of diverse successful body types. Significantly, the participants defined success by "what body can do rather than what it looks like, developing body competency focus that directly challenged dominant feminine body ideals emphasising appearance over function. This transformation occurred through what Hanold identifies as the disciplining effects of ultrarunning, whereby the sport's emphasis on finishing rather than speed created space for more diverse subjectivities than previously found in distance running literature. These findings suggest that ultra-endurance contexts may provide unique opportunities for female athletes to develop empowered relationships with pain and physical capability that transcend traditional gender limitations.

Female ultra-athletes have progressively demonstrated these physiological and psychological capabilities through groundbreaking competitive achievements that challenge traditional assumptions about gender-based limitations. During the 1980s through 2004, Ann Trason broke 20 world records across distances ranging from 40 to 100 miles, holding the ultra-runner of the year title for over a decade. Her performances sparked the first serious debates about women's potential advantages in ultra-endurance events, with her times in some races exceeding those of male competitors and raising questions about whether women might systematically excel at extreme distances. In 2016, Emily Chappell's victory in the Transcontinental Race demonstrated women's capacity to excel in multi-day cycling events requiring mental resilience over pure physical power. As Chappell noted: "Once you've been riding for several days, it becomes less about your ability to sprint up a hill, and much more about resilience, determination, and the will to keep going, qualities which women possess as

abundantly as any man" (Chappell, 2019, p. 1). This observation captures the fundamental shift in performance determinants that occurs as event duration extends beyond traditional endurance boundaries.

Fiona Kolbinger's 2019 victory in the Transcontinental Race represented a watershed moment in demonstrating female ultra-endurance capabilities. She completed the 2,485-mile journey from Bulgaria to France in just over 10 days, finishing 10 hours ahead of her closest competitor in a field of over 200 men and 39 women. This achievement challenged traditional assumptions about gender performance gaps in ultra-endurance events, occurring in an unsupported race format requiring navigation, equipment management, and strategic decision-making alongside sustained physical effort. Shanda Hill made history in 2024 as the first woman to complete a Continuous Triple Deca Triathlon, encompassing 30 Iron-distance triathlons over 45 days. Her completion of this event, sanctioned by the International Ultra Triathlon Association (IUTA), demonstrated extraordinary physical and mental resilience despite experiencing significant pain from injuries including pulled groin muscle and blistered feet. Hill declared: "If I have to crawl, I will cross that finish line" (IUTA, 2024), exemplifying the pain tolerance and determination characteristic of female ultra-athletes navigating extreme physical challenges. This achievement proved prophetic of Hill's 2025 completion of a Continuous Deca Iron Triathlon (10 × Ironman distance) in Rio de Janeiro, Brazil, where she became only the second woman ever to achieve this feat and the sole female finisher among competitors that year (IUTA, 2025).

As Knechtle et al. (2015) demonstrated in their analysis of ultra-triathlon performance, previous experience proved important for longer ultra-triathlon races, with personal best times in shorter races more predictive than the number of previously finished races. Hill's extraordinary accomplishments were built upon extensive ultra-triathlon experience, having completed multiple Double and Triple Iron distances before attempting

longer events, exemplifying how female ultra-athletes develop pain tolerance and coping strategies through progressive experiential learning across increasingly challenging distances. These achievements are not exceptional outliers but rather demonstrate the systematic pattern of performance convergence identified in the statistical analyses—real athletes in real competitions progressively challenging assumptions about female capabilities in extreme endurance contexts.

This convergence in ultra-endurance performance represents more than statistical curiosity—it challenges fundamental assumptions about female athletic capability that have historically justified exclusion from sporting participation. The systematic reduction in performance gaps across multiple ultra-endurance disciplines suggests that traditional sporting paradigms, designed around brief, high-intensity efforts, may not adequately capture female physiological and psychological capabilities. Traditional performance metrics emphasising power output, sprint capacity, and anaerobic systems may systematically undervalue the fatigue resistance, metabolic efficiency, and pain tolerance capabilities where female athletes demonstrate advantages. This performance convergence provides compelling rationale for investigating female ultra-athletes' pain experiences as potentially distinct from both traditional sporting contexts and male-focused ultra-endurance research. This would be specifically achieved by examining how women interpret and manage the extreme physical challenges that their competitive achievements demonstrate they can successfully navigate.

### 1.3.2 The Paradox: Participation Growth Versus Research Underrepresentation

Despite dramatic increases in female ultra-endurance participation, with women now representing approximately 25% of participants globally, systematic analyses reveal significant gender disparities in research participation that lag decades behind actual participation patterns. This temporal disconnect between cultural participation and scientific investigation creates what amounts to a knowledge crisis, where increasing numbers of

female athletes navigate extreme physical and psychological challenges with minimal evidence-based guidance specific to their experiences.

Existing research representation fails to reflect participation realities. Elliott-Sale et al.'s (2021) comprehensive analysis highlighted that most high-quality sport and exercise science data have been derived from studies with men as participants due to a shortage of specialist knowledge on female physiology in the sport science community, coupled with a reluctance to effectively adapt experimental designs to incorporate female-specific considerations. This systematic exclusion extends prominently into ultra-endurance research, where gender disparities in study samples remain pronounced despite growing female participation. Roebuck et al.'s (2018) systematic review of 51 studies examining psychological characteristics of ultra-marathon runners found pain perception research included only 22% female participants, with just 13 females compared to 47 males across combined pain-focused studies. This 78% male representation occurs despite ultra-endurance participation ratios improving dramatically from 22.2:1 in 1980 to 3.4:1 in 2019, meaning research representation lags approximately three decades behind actual participation patterns.

Even the most recent comprehensive interdisciplinary reviews explicitly acknowledge this limitation while perpetuating it: Berger et al.'s (2024) comprehensive interdisciplinary perpetuated this gap despite acknowledging female physiological advantages in fatigue resistance and metabolic efficiency. This decision to exclude gender-specific analysis in comprehensive reviews means that accumulated knowledge about ultra-endurance pain experiences continues to derive predominantly from male participants, with findings assumed applicable to female athletes without empirical verification. Similarly, Paley and Johnson's (2025) influential review of ultra-endurance pain coping relies heavily on studies with zero female participants for key pain tolerance findings (e.g., Freund et al., 2013), presenting conclusions as universally applicable despite 17 or more source studies having unspecified

gender composition and no systematic quality assessment for gender representation. These methodological limitations perpetuate what researchers' term biased literature that fails to capture female-specific experiences (Keogh et al., 2024).

This underrepresentation extends beyond simple numerical inadequacy to encompass systematic quality issues in existing female-focused research. Smith et al.'s (2022) comprehensive audit protocol reveals that female athletes remain substantially underrepresented across sport science research despite growing participation rates, with their analytical framework identifying that recognition that erroneous extrapolations may hamper the efforts of females to maximise their athletic potential has created an impetus to acknowledge and readdress the sex disparity in sport science research. Cowley et al.'s (2024) analysis of 438 female-only studies found that research quality was significantly higher when women authors were involved ($p = .00\text{-}.04$), with only studies having women as first, last, and both authors demonstrating higher quality scores for female-specific methodological considerations. This finding suggests that current research approaches may be systematically inadequate for capturing female-specific experiences when conducted primarily by male researchers using protocols designed for male participants. This is a potential methodological concern with profound implications for researchers ensuring quality and rigour when seeking to understand female-specific experiences (Burke, 2016).

The persistence of this research gap reflects broader patterns extending beyond ultra-endurance contexts to encompass exercise science generally. This underrepresentation has deep historical roots (as highlighted in section 1.1), compounding ultra-endurance research gaps and creating conditions where female athletes navigate extreme pain experiences with minimal scientific understanding of how their biological, psychological, and social contexts shape those experiences. The American College of Sports Medicine's (ACSM) consensus statement explicitly identifies that a major step toward closing the knowledge gap is to

include more and equitable numbers of women to that of men in mechanistic studies (Hunter et al., 2023), confirming that female underrepresentation constitutes a recognised problem across sport and exercise science disciplines. This legacy of exclusion compounds ultra-endurance research gaps, creating conditions where female athletes navigate extreme pain experiences with minimal scientific understanding of how their biological, psychological, and social contexts shape those experiences.

The research-to-practice translation challenges compound these representation issues. Lebel et al.'s (2021) analysis of women's sport research stakeholders found that despite decades of advocacy, only a few 'sticky statistics' like the 4% media coverage figure have achieved meaningful industry recognition and informed decision-making. Their research revealed siloed differences of opinion based upon the age and role of the stakeholder in the women's sport ecosystem, suggesting that academic research struggles to translate into practical change even when conducted. This challenge is magnified by systematic research scarcity, as evidenced by Jackman et al.'s (2024) scoping review of women's sport research within Ireland, which identified only 274 peer-reviewed outputs despite comprehensive database searching across multiple disciplines, confirming persistent research marginalisation of female sporting experiences even in contexts with strong sporting traditions.

Gender disparities become even more pronounced at extreme ultra-endurance distances, creating what amounts to near-complete female absence in research and competition at the longest events. International Ultra Triathlon Association (IUTA) data demonstrates this pattern clearly: the 2025 Double Iron World Championships in Emsdetten included 28 male and 8 female participants, representing just 22% female participation (IUTA, 2025). However, this disparity intensifies dramatically at longer distances. Historical Deca Iron events show complete female absence, with 2015-2017 competitions recording 0 female participants across 17 total finishers (IUTA, 2015, 2016, 2017), and the 2019 Double

Deca Iron event in León recording 0 female participants among 4 finishers (IUTA, 2019). As previously mentioned earlier, these statistics demonstrate what Knechtle et al. (2015) the importance of previous experience in ultra-triathlon success, where systematic progression through shorter distances typically precedes longer attempts. The near-complete absence of women at extreme distances suggests that female athletes may face additional barriers— whether physiological, psychological, social, or structural—in developing the experiential foundation necessary for these events, making achievements like Shanda Hill's 2025 Deca Iron completion particularly remarkable as breakthrough demonstrations of female ultra-endurance capability.

The institutional lag reflects Capranica et al. (2013) framework identified in 1.1. This framework provides crucial context for understanding how historical exclusion continues to influence current research gaps in ultra-endurance contexts, where women now represent nearly 25% of participants yet remain systematically underrepresented in research literature, creating conditions where female athletes' capabilities have substantially exceeded both historical expectations and scientific investigation of their experiences.

**1.4 Why Female-Specific Investigation is Essential**

Having established both the performance capabilities of female ultra-athletes and the systematic underrepresentation in research, it is crucial to articulate why dedicated female-specific investigation is not merely desirable but essential. Modern pain science confirms that pain experiences cannot be understood through single-dimension perspectives. The International Association for the Study of Pain (2020) defines pain as always a personal experience influenced by biological, psychological, and social factors. For female ultra-endurance athletes, this multidimensional nature creates distinct complexity requiring dedicated investigation that extends beyond gender-neutral frameworks or male-derived models.

Female ultra-athletes face unique challenges across all three biopsychosocial domains. Biologically, women demonstrate different pain sensitivity patterns across the lifespan, with generally lower pain thresholds and tolerance compared to men, with differences emerging particularly from puberty onwards (Keogh et al., 2024). Female athletes must manage female-specific pain conditions—including dysmenorrhea affecting up to 90% of young women, endometriosis affecting approximately 1 in 10 women, and other conditions such as vulvodynia and pregnancy-related pain (Pogatzki-Zahn et al., 2024), alongside the exercise-induced pain typical of ultra-endurance participation. Additionally, recent research has identified sex-specific genetic and cellular pain processing mechanisms, with at least 49 genes/proteins implicated in chronic pain processing in males but not females, and 35 genes/proteins implicated in females but not males, alongside hormonal influences where oestrogen demonstrates pain-suppressing effects at higher concentrations but pain-amplifying effects at lower concentrations (Mogil et al., 2024). These biological factors create fluctuating pain experiences across menstrual cycles and life transitions that interact with ultra-endurance demands in ways that remain largely unexplored.

Psychologically, female athletes demonstrate distinct pain processing patterns compared to males. Sullivan et al.'s (2000) research demonstrated that women display pain behaviours for significantly longer duration than men during experimental pain tasks, with these differences mediated by catastrophising—a cognitive pattern where women engage in more rumination and helplessness thinking about pain experiences. Sport-specific research confirms that female endurance athletes may use more dissociative cognitive strategies (mental distraction from bodily sensations) compared to male athletes who prefer associative strategies focusing on physical sensations (Antonini Philippe & Seiler, 2005). As Keogh (2022) demonstrates, these gender differences in pain experience and coping emerge

particularly strongly from adolescence onwards, with women facing pain-related challenges that far exceed those experienced by males throughout reproductive years.

Socially, women navigate gendered expectations that create what Krane et al. (2004) term 'dual and duelling identities' simultaneously performing athleticism requiring extreme pain tolerance, while managing cultural conditioning toward pain avoidance traditionally associated with femininity. Researchers have confirmed that women are culturally conditioned to avoid pain while tolerance of pain is indicative of strength and endurance, more synonymous with masculinity (Antonini Philippe & Seiler, 2005), creating tensions between sporting demands and gendered social expectations. Defrin et al.'s (2009) experimental research revealed that gender role expectations of pain significantly influence tolerance limits, with cognitive-emotional factors mediating the expression of biological sex differences. As Karos et al. (2024) demonstrate through their four-level biopsychosocial framework, gender operates across multiple interconnected levels—from intra-individual embodied experiences through interpersonal interactions to positional factors affecting resource access and ideological structures creating systematic biases. This multilevel operation creates asymmetries in the value attributed to female/women's pain experiences, potentially reflected in less funding for research on female-specific pain conditions and systematic struggles for women to see their pain complaints legitimised in clinical and sporting contexts.

Previous researchers have documented single-discipline aspects of ultra-endurance pain. However, pain experiences are from complex interactions across biological, psychological, and social domains rather than operating within discrete categories thus comprehensive understanding requires integrated biopsychosocial investigation (Berger et al., 2024). As Allen-Collinson and Jackman (2022) argue, the concept of endurance work provides a powerful example of the cognitive-corporeal nexus and the mind-body-world

linkage, as emphasised by existential phenomenology. The interaction between female-specific biological vulnerabilities, distinct psychological processing patterns, and gendered social expectations creates complexity that cannot be captured through male-derived models, gender-neutral frameworks, or single-discipline approaches. Female ultra-athletes' participation and capabilities have dramatically outpaced scientific understanding of their specific experiences, creating an urgent imperative for dedicated investigation employing integrated theoretical frameworks capable of capturing this multidimensional complexity.

## 1.5 Philosophical Framework

### 1.5.1 Pragmatic Worldview and Mixed Methods in Sporting Contexts

The philosophical framework adopted for underpinning the research aims and interpreting how ultra-endurance pain represents a complex phenomenon requiring multiple investigative lenses. This complexity aligns with research problems that are integrated (Poth, 2018) and informed the researcher's adoption of a pragmatic worldview for using mixed methods approaches, i.e., both quantitative and qualitative methods (Onwuegbuzie & Leech, 2005). Pragmatism focuses on practical consequences of research findings and values both objective and subjective knowledge (Creswell & Creswell, 2020). This approach aligns with using a biopsychosocial lens for researching pain within ultra-endurance sports, as it reflects the multidimensional nature of pain experience. Current mixed methods scholarship emphasise moving beyond simple methodological mixing towards dynamic interdependence where different approaches become genuinely integrated (Bazeley, 2024).

While pragmatism in MMR has faced critique regarding philosophical interpretation and definitional clarity (Bergman, 2011; Denzin, 2012; Hesse-Biber, 2010), substantial progress has been made in establishing MMR as a distinct and rigorous research paradigm. The field has matured considerably over the past decade, with MMR now recognised as one of three major research paradigms alongside quantitative and qualitative approaches,

supported by an established community of scholars sharing exemplary and methodological standards (Fetters & Molina-Azorin, 2017). Concerns have been systematically addressed through frameworks that distinguish between quality and rigour, establishing clear criteria for conducting and reporting MMR studies across primary elements (data collection, analysis, integration, and design type) and advanced elements (aims, purpose, and methodological writing) (Harrison et al., 2020). The paradigm debate itself has been clarified by distinguishing between paradigms as shared exemplars within communities and worldviews encompassing ontological and epistemological assumptions, demonstrating that MMR can legitimately combine different philosophical stances while maintaining methodological coherence (Ghiara, 2020).

Rather than representing incompatibility, the combination of different paradigms enables epistemological and ontological pluralism that enriches understanding by intentionally allowing for disharmony and provocative insights, particularly through approaches such as initiation that seek paradoxes leading to reframing of research questions (Ghiara, 2020). Furthermore, the field has moved beyond simplistic associations between paradigms and methods, developing distinct MMR terminology and principles for establishing new language while divesting problematic legacy terms (Fetters & Molina-Azorin, 2017). This evolutionary development demonstrates MMR's maturation into a methodologically sound approach with established rigour standards and philosophical coherence. This programme of research aligns with MMR terminology and principles (Cresswell & Cresswell, 2020; (Fetters & Molina-Azorin, 2017) justifying methodological choices through demonstrated coherence with philosophical commitments rather than mere utility and treating knowledge as consequential and fallible (Gillespie et al., 2024). The approach maintains interpretivist commitments and lends itself to understand female ultra-

endurance athletes' pain experiences by adopting different investigative tools within an integrated meaning-making research focus.

Sport and exercise researchers have been notably slow to adopt mixed method approaches. Gibson (2016) observes that mixed method research does not currently occupy a prominent place within sport and exercise literature, despite growing recognition of complex phenomena requiring multiple investigative approaches. The mixed method research gap reflects broader disciplinary tensions where sport science has historically privileged postpositivist approaches (Sparkes, 2015), creating institutional pressures that marginalise interpretivist methodologies. McGannon and Schweinbenz (2011) demonstrate that sport psychology maintains a qualitative-quantitative divide where methodological choices become identity markers—what Ryba et al. (2020) term paradigmatic entrenchment. For ultra-endurance pain research, these disciplinary limitations are particularly problematic because pain experiences simultaneously involve measurable neurophysiological processes and deeply subjective meaning-making. This programme of research addresses sport-specific MMR challenges by adopting paradigmatic awareness through explicit articulation of ontological and epistemological positions (Sparkes, 2015). It operationalises innovative mixed methods adapted for sport psychology contexts (Ryba et al., 2020) and demonstrates temporal integration driven by ultra-endurance characteristics rather than formulaic application of generic frameworks.

### 1.5.2 Ontological and Epistemological Positioning

A pluralist ontology was adopted, recognising multiple valid ways of constructing and interpreting pain realities. This ontological position acknowledges that female ultra-endurance athletes may inhabit different pain realities shaped by individual experiential worlds, shared phenomenological patterns and physiological dimensions (Onwuegbuzie & Leech, 2005). The temporal dimension is particularly crucial, as lived experience is

essentially temporal in nature (Neale, 2025), requiring recognition that pain experiences unfold within dynamic systems where coping strategies evolve and meanings shift throughout events. The research is grounded in an interpretivist epistemological approach emphasising understanding phenomena through the meanings people assign to them. This epistemological approach recognises that knowledge is socially constructed and context-dependent, values detailed examination of individual experiences, acknowledging the researcher's role in interpreting participants' accounts. The interpretivist tradition holds that the social world is experienced, interpreted, constructed, and transformed by its members through their everyday actions and interactions (Creswell & Creswell, 2020; Neale, 2025).

Critically, epistemological pluralism maintains that multiple forms of knowledge can be produced without imposing concomitant ontological claims, enabling diverse perspectives within consistent ontological frameworks to produce complementary rather than contradictory knowledge (Clarke et al., 2015). Current mixed methods researchers have embodied multiple epistemological frameworks within a single study whereby different approaches serve complementary knowledge-generation purposes (Ghiara, 2020).

For this PhD thesis, epistemological pluralism manifests as three complementary approaches: Study 1 accesses athletes lived experiences through interpretative phenomenological analysis, producing knowledge about retrospective subjective meaning-making and embodied learning experiences; Study 2 systematically documents pain experience patterns longitudinally, producing knowledge about temporal development and evolving events; Study 3 provides real-time pain experiences, producing knowledge about immediate pain interpretation and coping strategies. The temporal sequencing employed represents transformative sequential design where each phase actively informs subsequent investigations (Creswell & Plano Clark, 2018).

All three approaches operate within the pluralist ontology, acknowledging pain realities are multiple, contextual, and constructed through meaning-making (Clarke et al., 2015). Coherence lies in maintaining clarity about what each method enables us to understand, demonstrating methodological bricolage - using tools reflexively and dynamically to craft knowledge within coherent philosophical frameworks (Gibson, 2016). These ontological and epistemological commitments fundamentally shape what counts as legitimate knowledge about female ultra-athletes' pain experiences. A pluralist ontology necessitates methods capturing multiple contextually embedded pain realities as validly constructed by athletes themselves, rather than privileging researcher-defined variables seeking generalisable laws (Smith, 2018). The interpretivist epistemology determines whether pain rating scales represent objective/subjective measurement or constructed narratives, whether laboratory-induced pain reflects ultra-endurance experiences or fundamentally different phenomena, and whether participant variation constitutes measurement error or substantive diversity requiring exploration (Burke, 2016; Creswell & Creswell, 2020). For ultra-endurance pain research specifically, these philosophical commitments reject foundationalist quality criteria premised on objective verification—such as traditional validity, reliability, and generalisability—as ontologically incompatible, requiring instead contextually-situated quality markers appropriate to interpretivist inquiry (Burke, 2016; Sparkes & Smith, 2009).

### 1.5.3 Quality Criteria, Integration, and Critical Positioning

The interpretivist epistemology and pluralist ontology underpinning this research require quality criteria aligned with these commitments rather than positivist standards presuming objective, singular reality (Burke, 2016). Quantitative components are assessed through systematic rigour of established instruments, while qualitative components employ quality markers appropriate to interpretivist inquiry. Quality markers include substantive

contribution (advancing understanding of female ultra-athletes' pain experiences), resonance (enabling naturalistic generalisation through rich description; Smith, 2018), and ecological validity (capturing pain in naturalistic competitive settings; Smith, 2018).

Integration quality for the multi-phase design incorporates is demonstrated through convergence, divergence, and expansion across data sources using joint display tables systematically comparing findings across data sources, temporal weaving showing how each study phase informed subsequent investigations, and meta-inferences synthesising understanding across the research programme (Cresswell & Cresswell, 2020; Guetterman et al., 2015; Plano Clark & Sanders, 2015).

The mixed method research approach serves knowledge translation goals (Ivankova et al., 2024) ensuring that researchers ensure their findings are academically rigorous for theory development, practically applicable for coaches and athletes, clinically relevant for sports medicine practitioners, and methodologically informative for future researchers. This interdisciplinary applicability reflects equitable research design ensuring knowledge benefits extend beyond academic circles to those directly involved in ultra-endurance participation and support (Corrigan & Onwuegbuzie, 2024).

### 1.5.4 Researcher Positioning

The programme of research was informed by the researcher's extensive practical experience in sport science education and elite athlete support. Through roles in UK further education colleges teaching sport science and working as sports massage therapist within interdisciplinary medical teams, the researcher cultivated comprehensive understanding of how theoretical frameworks translate into practical applications. This understanding was strengthened by direct involvement with elite athletes during major international events, including the 2004 Athens Olympics, 2012 London Olympics, and 2012 London Paralympics.

The researcher's experiential background reflects the biopsychosocial lens adopted for the thesis and informed the adoption of a pragmatic worldview, pluralist ontology, and interpretative epistemology. This positioning addresses calls for researchers with specialist knowledge on female physiology and methodological sophistication to overcome the systematic reluctance to effectively adapt experimental designs to incorporate female-specific considerations that has characterised sport and exercise science research (Elliott-Sale et al., 2021). Recognising that stories are embodied and told with, in, through, on, and out of bodies (Smith & Monforte, 2020), the researcher's practical experience provided embodied understanding while maintaining analytical competence worked up systematically and rigorously through multiple methodological approaches, serving as methodological asset enabling nuanced interpretation of athletes' pain narratives while maintaining critical analytical distance. This approach aligned with the researcher's real-world practice orientation and the requirement for viewing ultra-endurance experiences as holistic and interactive processes (Cresswell & Cresswell, 2020; Onwuegbuzie & Leech, 2005). The reality that ultra-endurance takes place across varied settings necessitates this comprehensive approach, as multiple factors affect athlete performance and pain experience (Best et al., 2018; Judelson et al., 2015b; McNarry et al., 2020).

**1.6 Focus of the PhD**

Having established the historical exclusion, present-day growth, performance capabilities, systematic research underrepresentation, and distinct biopsychosocial challenges facing female ultra-endurance athletes, this thesis aims to advance understanding of female ultra-endurance athletes' pain experiences at theoretical, methodological, and practical levels.

By addressing identified gaps in current research, this work will contribute to knowledge in several significant ways. At the theoretical level, the research will extend current understanding of gender-specific aspects of ultra-endurance performance by

examining how biological sex differences, psychological processing patterns, and gendered social contexts interact to shape pain experiences. This integrated biopsychosocial approach will address the identified gap where previous research has examined these domains in isolation, providing a more comprehensive framework for understanding female ultra-athletes' capabilities and challenges.

Methodologically, the research will demonstrate the value of integrating multiple temporal perspectives in sport research. The implementation of a multi-phase mixed methods design—examining retrospective sense-making, longitudinal experiential learning, and real-time cognitive processing—addresses the identified limitation where current research relies predominantly on laboratory-based studies with brief exercise protocols. This approach provides a framework for investigating other complex athletic phenomena while capturing contextual authenticity and ecological validity through data collection in actual ultra-endurance contexts (Burke, 2016; Smith, 2018).

In terms of practical application, the findings will inform evidence-based strategies for athlete support and preparation, addressing the knowledge gap where female athletes navigate extreme challenges with minimal female-specific guidance. By providing coaches, medical professionals, and athletes themselves with understanding of how they specifically experience and manage ultra-endurance pain, the research contributes to more effective support practices that acknowledge rather than ignore gender-specific considerations. Through this systematic investigation, this thesis will make an original contribution to understanding ultra-endurance pain experience and coping, and how female ultra-athletes manage the biopsychosocial demands of their sport, with implications for both theory and practice in ultra-endurance athletics.

Having established the research context, philosophical framework, and focus of this thesis, the following chapter presents a comprehensive review of literature pertaining to pain

in ultra-endurance contexts. Chapter Two examines fundamental pain theories, their application to sports-specific contexts, and synthesises current knowledge through a biopsychosocial lens, identifying the crucial gaps in understanding female ultra-athletes' pain experiences that this research aims to address.

## Chapter Two: Literature Review

This chapter establishes the theoretical foundation through a comprehensive review of relevant literature. The review begins by examining fundamental pain theories through a biopsychosocial lens, then explores specific manifestations of pain in ultra-endurance contexts and finally identifies crucial gaps in current understanding that this thesis aims to address. This review provides the theoretical foundation that informs the methodological approaches outlined in the research design and justifies the significance of examining female athletes' experiences through multiple temporal perspectives.

## 2.1 The biopsychosocial lens for understanding female ultra-endurance pain experiences

The following sections examine present-day definitions of pain, followed by the evolution of pain theories across biological and psychosocial domains, before exploring how these integrated frameworks help provide a comprehensive lens for understanding female ultra-athletes' pain experiences.The multidimensional and subjective nature of pain experiences across different ultra-sports necessitates an integrated theoretical approach that examines biological, psychological, and social dimensions across multiple temporal phases. The biopsychosocial model provides an integrated framework for examining pain as a multidimensional experience shaped by the complex interplay between biological processes, psychological factors, and social contexts. First proposed by Engel (1977), this approach recognises that pain cannot be reduced to a single dimension but must be understood as an experience influenced by interactions across these three domains. For female ultra-endurance athletes, this perspective is particularly valuable as it captures both the physiological underpinnings of pain and the psychological and social factors that influence how pain is interpreted, managed, and given meaning within the context of ultra-endurance sport.

### 2.1.1 Contemporary definitions of pain

The International Association for the Study of Pain (IASP) recently updated their definition of pain to reflect this multidimensional understanding: "An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (IASP, 2020; Raja et al., 2020). This definition emphasises several critical aspects: first, pain is always a personal experience influenced by biological, psychological, and social factors. Second, pain cannot be inferred solely from sensory neuron activity. Third, pain understanding develops through life experiences. Fourth, a person's report of pain should be respected. Lastly, pain can have both adaptive and adverse effects on function and wellbeing. Building on the biopsychosocial framework established in Chapter 1, pain researchers demonstrate the crucial importance of understanding pain as an integrated phenomenon rather than isolated biological, psychological, or social experience (Bernardes et al., 2008). However, systematic reviews of pain research using biopsychosocial theoretical frameworks revealed gender-disaggregated data and thus the female pain experience remaining underreported (Peacock & Patel, 2008; Rogger et al., 2023), limiting understanding of how pain experiences differ across both gender and cultural contexts. Gender role expectations significantly influence both self-perception and pain experiences. Women often perceive themselves as more willing to report pain, while men tend to see themselves as more tolerant. These beliefs affect pain thresholds and tolerance: individuals who identify with masculine traits report higher pain tolerance, whereas those endorsing feminine traits report lower thresholds and greater pain unpleasantness (Bernardes et al., 2008). Moreover, the impact of these expectations is moderated by social identity - individuals who strongly identify with their gender group are more influenced by normative beliefs about how an "ideal" man or woman should respond to pain (Pool et al., 2007).

Current understanding recognises pain as distinct from related concepts that frequently co-occur during ultra-endurance activities. Ashkenazy and DeKeyser Ganz (2017)

demonstrated through concept analysis that while pain is one of the causes for discomfort, not every discomfort can be attributed to pain. Discomfort is characterised as an unpleasant feeling resulting in a natural response of avoidance or reduction, requiring different interpretive and management approaches than pain itself. Understanding this distinction between discomfort and pain is crucial for ultra-endurance contexts where athletes encounter multiple simultaneous unpleasant sensations requiring accurate evaluations of seriousness and risk management. Furthermore, sport-specific researchers revealed that pain perception can vary across athletic populations. For example, Assa et al. (2019) demonstrated that endurance athletes displayed lower fear of pain levels and enhanced heat pain tolerance and stronger conditioned pain modulation compared to strength athletes. Their analysis indicated that endurance-based sports are potentially associated with improved pain inhibition mechanisms and pain processing capabilities. Stevens et al. (2018) confirmed that endurance performance involves complex interactions between pain, temperature perception, and effort sensation, requiring athletes to distinguish between these overlapping but distinct experiences.

Recent comprehensive reviews provide updated frameworks for understanding these distinctions in ultra-endurance contexts. Paley and Johnson (2025) demonstrated that ultra-endurance athletes must distinguish between pain (nociceptive sensations requiring active management), fatigue (reduced performance capacity), and general discomfort (unpleasant but non-threatening sensations). Their research analysis identified that ultra-endurance athletes possess enhanced pain modulation capabilities through multiple mechanisms: more efficient neurophysiological pain inhibition systems, superior psychological resilience characteristics, and adaptive coping strategies. Critically, Paley and Johnson (2025) identified that pain can function as part of a ritualistic transition process or rite of passage within ultra-endurance communities, creating social bonding experiences that transform individual

suffering into collective meaning-making. In summary, adopting a biopsychosocial lens to explore the pain experiences would best reflect the combined interactions of these factors that can influence pain or discomfort evaluations and subsequent decision-making on coping.

The IASP revised conceptualisation highlights the multidimensional dimensions of pain and aligns with ultra-endurance contexts, where athletes must interpret and respond to various pain experiences while managing complex interactions between physical demands, psychological states, and social environments. This framework resonates with the demands placed on ultra-endurance athletes who must persist through physical, psychological, and emotional challenges in pursuit of their goals (Jaeschke & Sachs, 2012). The framework applies across all ultra-endurance disciplines, including trail running (Allen-Collinson, 2016; Antonini-Philippe et al, 2016; Berger et al., 2020; Best et al., 2018; Johnson et al., 2016), open-water swimming (Judelson, et al., 2015a; McNarry et al., 2021), triathlon (Atkinson, 2008), and cycling (Kress & Statler, 2007). Having established current understanding of pain, the following section examines how pain theories developed historically toward this integrated perspective.

### 2.1.2 The biological development of pain theory and an integrated approach

Researchers ongoing understanding of pain has evolved significantly from early mechanistic models that viewed pain purely as a physiological response to tissue damage. This evolution reflects growing recognition of pain's complexity and the need for more practised theoretical frameworks to capture the multiple factors influencing pain experiences across different contexts and populations. The theory of pain, inherited in the 20th century, was proposed by Descartes (1664/1985), having been developed over three centuries of previous work (as cited in Payne & Horne, 1997). Descartes' early mechanistic conceptions of pain resulted in the biomedical specificity theory that proposed that a specific pain system transmits messages from receptors in the brain (Hadjistavropoulos & Craig, 2004). However,

it failed to explain many aspects of pain experience, including why similar injuries could produce vastly different pain responses in different individuals or contexts.

By the 1950s, significant and systematic involvement of psychologists in the field of pain began and the development of Gate Control Theory (Melzack & Casey, 1968) marked a crucial shift toward recognising pain as a complex phenomenon influenced by multiple factors. As illustrated in Figure 2.1, this theory demonstrates how pain signals are modulated through a complex system involving sensory-discriminative, motivational-affective, and cognitive-evaluative processes. The figure depicts how the gate control system processes nerve impulses, with transmission cells (T) being influenced by both ascending sensory signals and descending control mechanisms from the brain. This mechanism explains how ultra-endurance athletes can effectively 'ignore' pain through cognitive processes that close or partially close the gate. When athletes direct their attention away from pain signals or reinterpret them as non-threatening, descending signals from the brain can inhibit pain transmission at the spinal level. This neurophysiological process underlies the common ultra-endurance strategy of mentally compartmentalising or deprioritising pain sensations during competition. The visual representation highlights the revolutionary concept that pain is not simply a direct response to injury but is actively regulated through multiple neural pathways and cognitive processes, challenging the notion of pain as a purely sensory experience. Melzack & Katz (2012) proposed that nerve impulses from afferent fibres to spinal cord transmission cells are modulated by a gating mechanism in the spinal dorsal horn, with this mechanism influenced by both the relative activity in different nerve fibres and descending signals from the brain).

**Figure 2.1**

*Conceptual Model of Sensory, Motivational, and Central Control Determinants of Pain (Gate Control Theory: Melzack & Casey, 1968) (permission to be used by https://creativecommons.org/licenses/by/4.0/)*
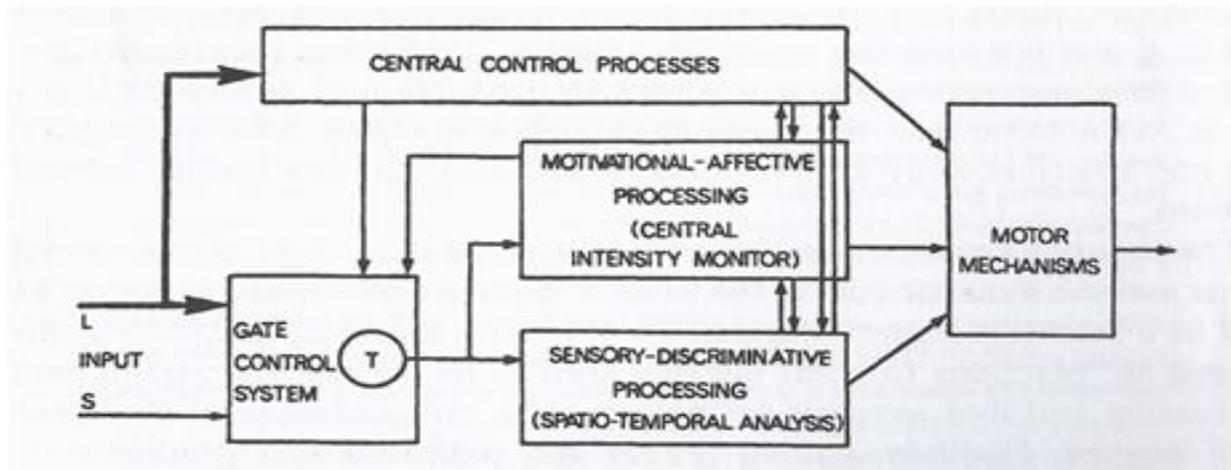


In the decades that followed the publication of the Gate Theory much has been learned about the neurobiological properties of nociceptors, the neurons, and pathways that are activated by injury, the transmitters, and molecular mediators of nociceptive information and the brain areas that integrate injury related signals (Cervero, 2013). Melzack and Casey (1968) proposed that specialised systems in the brain engage in the sensory-discriminative, motivational-affective, and cognitive-evaluative dimensions of subjective pain experiences, as seen in Figure 2.1 (Hadjistavropoulos & Craig, 2004). The output of the T transmission cells of the Gate control system projects to the sensory-discriminative system and the motivational-affective system. The central control trigger is represented by a line running from the large fibre system to the central control processes; these in turn, project back to the gate control system, and to the sensory-discriminative and motivation-affective systems. All three systems interact with one another, and project to a motor system (Hadjistavropoulos & Craig, 2004).

In the context of ultra-endurance performance, the Gate Control Theory helps explain how attention and interpretation influence pain perception during prolonged exertion. For example, this process could be likened to how much attention is paid to the pain signals through evaluation and interpretation and whether it is ignored or blocks the gate from opening to require further attention and a cognitive strategy to deal with it. Venhorst et al. (2018) applied these principles in developing a three-dimensional framework of centrally regulated and goal-directed exercise behaviours underpinning perceived fatiguability and pacing in the perceptual environment during exercise.

Building on Gate Control Theory, Melzack (2001) proposed the Neuromatrix Theory (see Figure 2.2) to explain phenomena that could not be accounted for by existing models. Figure 2.2 illustrates the complex, multidimensional nature of this theory, showing how the body-self neuromatrix integrates sensory (S), affective (A), and cognitive (C) neuromodules to generate the experience of pain. The diagram demonstrates how multiple inputs—including sensory signals, cognitive influences, and emotional states—converge within the neuromatrix to produce various outputs, including pain perception, stress regulation, and action programs. This visual framework is particularly valuable for understanding ultra-endurance pain as it shows how sensation, emotion, and cognition are not separate processes but integrated aspects of a unified experience.

**Figure 2.2**

*The Neuromatrix Theory Model (Melzack, 2001) (permission to be used granted by John Wiley and Sons; License Number: 6138240609928)*
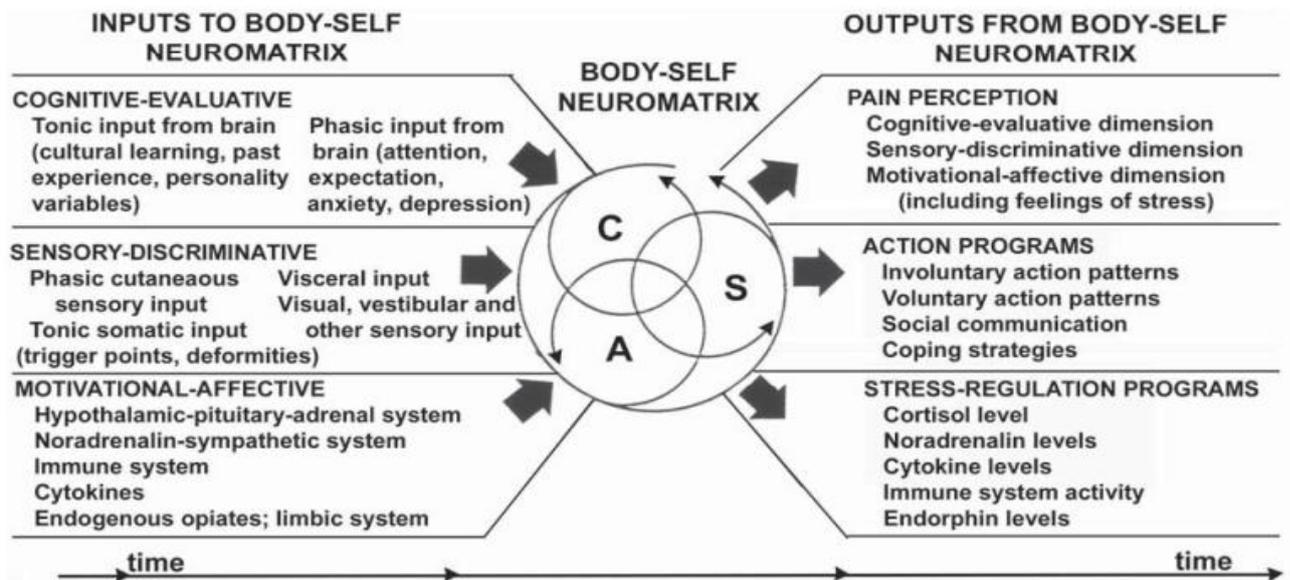


*Notes:* Factors that contribute to the patterns of activity generated by the body-self neuromatrix, which is comprised of sensory (S), affective (A), and cognitive (C) neuromodules. The output patterns from the neuromatrix produce the multiple dimensions of pain experience, as well as concurrent homeostatic and behavioural responses.

For female ultra-athletes, this model helps explain how various factors such as physical training, psychological preparation, and social context can simultaneously influence pain perception during competition. This theory conceptualises pain as emerging from a widely distributed neural network called the neuromatrix which generates characteristic patterns of nerve impulses or the neurosignatures. These neurosignatures are influenced by multiple inputs from sensory, cognitive, and motivational factors. The neuromatrix, is genetically determined and modified by multiple sensory experiences and is the primary mechanism that generates the neural pattern producing pain. Its output pattern is determined by further multiple influences converging on the neuromatrix, of which somatic sensory input

is only one part. Figure 2.2 summarises these factors that contribute to the output pattern from the neuromatrix that produces the sensory, affective, and cognitive dimensions of pain experience and behaviour. The neuromatrix consists of loops between the thalamus and cortex as well as between the cortex and limbic system, which undergo cyclical processing and synthesis to generate neurosignature patterns. These patterns may be triggered by sensory inputs but can also be generated independently, a concept particularly relevant to understanding phantom limb pain and other chronic pain conditions without obvious tissue pathology.

To contextualise the relevance of this theory to an ultra-endurance pain context, its three specialised systems in pain processing are particularly important: sensory-discriminative (physical sensation); motivational-affective (emotional responses); and cognitive-evaluative (interpretation and meaning-making) are key to how athletes determine the seriousness of their pain experiences during training or competition. This multidimensional conceptualisation aligns well to managing complex interactions between physical demands, psychological states, and social environments. For ultra-endurance athletes, pain is rarely just about physical sensation and understanding the complex emotional responses and cognitive interpretations that determine whether the athlete persists or withdraws are of interest to a range of practitioners, as well as for the athlete.

In addition to the pain experience, the Neuromatrix Theory further illuminates how stress systems interact with pain experiences such as in the limbic system for emotion and highlights an important consideration for the ultra-endurance athlete who experiences prolonged physical and psychological stress. Chronic stress activates complex neural, hormonal (e.g., cortisol and cytokins), and immune responses that can influence pain perception and may contribute to post-event pain conditions (Melzack, 2001). The theory explains how cortisol and other stress hormones released during prolonged exertion might

contribute to muscle damage, fatigue, and subsequent pain experiences in ultra-endurance athletes. The Neuromatrix Theory provides a framework for understanding how sensory pain inputs may be interpreted differently at different stages of an ultra-event, how athletes can experience severe pain without corresponding tissue damage, and how prior pain experiences and psychological factors like expectations and beliefs significantly influence pain perception during endurance events.

While the Neuromatrix Theory provides a comprehensive neurophysiological model for pain processing, it must be complemented by psychological and social frameworks to fully understand how athletes actively regulate their pain experiences. The following section examines these complementary frameworks.

### 2.1.3 Psychosocial theoretical frameworks for understanding ultra pain experiences

While the Neuromatrix Theory provides a comprehensive neurophysiological model for understanding pain generation and processing, it must be complimented by psychological and social frameworks to fully understand how ultra-endurance athletes actively regulate their pain experiences. The theoretical perspectives that are complementary and align well for understanding the psychosocial dimensions of pain experiences are tenets of the Social Cognitive Theory (Bandura, 1997), the cyclical phases of the Self-Regulation framework (Zimmerman, 2001), and the Metacognitive Framework of attentional focus and cognitive control (Brick et al., 2015). Together, these theories balance the complex interplay between physiological pain systems and psychosocial regulatory processes.

**2.1.3.1 Social Cognitive Theory.** The Social Cognitive Theory (Bandura, 1986, 1997) is relevant for examining female athletes' pain experiences as it recognises the interaction between personal, behavioural, and environmental factors, closely aligned with a psychosocial lens. Bandura (1991) describes self-regulation, a central concept of how individuals monitor and adjust their thoughts, feelings, and actions to achieve their goals, as

operating through three principal subfunctions (self-monitoring, judgemental function, self-reactive influence) that can apply to how female ultra-endurance athletes manage pain. First, self-monitoring whereby a practiced awareness of pain signals, physical limits, and responses to discomfort is developed during ultra-events. Research with experienced endurance athletes demonstrated the internal monitoring systems that differentiate between different types of pain and discomfort (Johnson et al., 2023; Whitehead et al., 2018).

Second, judgmental function is the evaluation of pain experiences against personal standards and environmental contexts. This includes comparing current pain levels against previous experiences, assessing pain against social referential comparisons (how other female athletes handle similar conditions), judging pain relative to the value placed on the activity (finishing an ultra-marathon), and attributing pain to controllable or uncontrollable factors. Lastly, the self-reactive influences refer to self-incentive systems and affective self-reactions that motivate continued effort despite pain. For example, the anticipated satisfaction of persevering through pain becomes a positive motivator, while disappointment with stopping becomes a negative motivator.

Bandura (1997) emphasises self-efficacy as central to self-regulation, which plays a crucial role in pain tolerance during training and competition situations. According to Bandura's theory, individuals with stronger self-efficacy beliefs demonstrate greater persistence when facing challenges, develop more constructive thought patterns, and experience lower stress levels when confronting demanding environmental conditions (Bandura, 1997). This is supported by recent evidence that injury and pain contribute to lowered self-efficacy beliefs, while good health or lack of injury influences higher self-efficacy beliefs (Shipherd et al., 2021). In their mixed-methods study of 78 runners (68% female sampling) across various experience levels and race distances including ultramarathons, Shipherd et al. (2021) found that physiological information (including pain,

fatigue, and injury) was consistently one of the most influential sources of self-efficacy throughout training. These findings further demonstrated that how runners interpret and respond to physiological sensations may change over time with experience, suggesting that pain interpretation is a developmental process aligned with Bandura's concept of experiential learning through mastery experiences.

An important consideration in developing pain interpretation and appropriate coping strategies is the temporal nature of experiential learning, which consolidates this cognitive process. Bandura (1991) distinguishes between proactive and reactive control, which applies to temporal dimensions of pain management. First, proactive control refers to the development of anticipatory strategies for expected pain, setting mental frameworks before an event starting. Reactive control refers to real-time adjustments to unexpected pain challenges, for example, Di Fronso et al. (2018) documented how endurance athletes shifted attentional strategies in response to evolving pain experiences during events. The dual system allows for both advance preparation and flexible adaptation during prolonged painful experiences. As Bandura notes, "Human self-motivation relies on both discrepancy production and discrepancy reduction" (Bandura, 1991, p. 260), suggesting successful pain management requires both setting challenging pain tolerance goals and making continuous adjustments during an event. This conceptualisation aligns with Jackman et al.'s (2024) findings that female ultra-runners employ dynamic goal revision strategies during extended events like 24-hour races.

As noted by Jackman et al. (2024a), the use of goal systems (Bandura, 1997; Bandura & Locke, 2003) can enhance pain tolerance using hierarchical goal systems to help athletes persist through immediate pain for longer-term achievement. For example, an athlete may have three goals (A, B, and C) as a back-up to assist finishing the race if pain or other demands become too much to cope with. This aligns with Bandura's concept that achieving

shorter-term objectives generates feelings of accomplishment and satisfaction that serve as intrinsic motivation while pursuing broader, more challenging long-term aspirations (Bandura, 1991). Research with ultra-marathoners confirms that experienced athletes employ hierarchical goal structures that balance immediate pain management with longer-term event completion objectives (Holt et al., 2014).

In terms of the social aspects of pain experience, Bandura's research on social learning and comparison has important implications for female ultra-athletes. Through vicarious experience of observing other female ultra-athletes' progressive mastery experiences of coping with their pain experiences, athletes can increase their own self-efficacy to cope with pain. Also, Simpson et al. (2014) documented how the ultra-running community facilitated knowledge exchange about pain management, creating social learning opportunities that align with Bandura's theoretical model. Additionally, through learning from pain experiences, athletes develop the skill of cognitive restructuring, which involves reframing pain experiences to promote a more positive mood and greater pain tolerance when required (Bandura, 1997; Bastian et al., 2014; Johnson et al., 2016). For example, Bluhm and Ravn (2022) documented how elite runners develop practiced meaning-making strategies that align with Bandura's cognitive restructuring principles, including "shuffling" with pain rather than fighting against it and context-dependent interpretations that assign different meanings to similar physical sensations based on race context and stage.

*2.1.3.2 Self-Regulation Framework.* Drawing from Bandura's Social Cognitive Theory subfunctions of self-regulation (i.e., monitoring, judgemental function, and self-reactive influences), Zimmerman (2000) provides a valuable self-regulation framework that is pertinent for examining how female ultra-athletes will monitor and adjust their responses to pain across different temporal phases of ultra-events. This cyclical model identifies three phases that help explain the development of practiced pain management approaches.

The first phase of self-regulation is the forethought phase which refers to processes and beliefs that happen before the activity takes place, such as planning, goal setting, and activation of strategies, in the form of task analysis and self-motivation beliefs. For example, in the task analysis before a Deca-triathlon, athletes will set goals to be achieved each day, such as ticking off each small goal towards achieving an ironman each day, while planning food and sleep as part of their overall strategy. The self-motivation beliefs involve self-efficacy beliefs about coping with pain, outcome expectations, and intrinsic interest. Self-efficacy influences the amount of effort an individual is willing to expend and their perseverance when faced with difficulties and setbacks (Bandura, 1997) most pertinent to a Deca-triathlete.

The performance phase in self-regulation refers to processes that happen during the activity or behavioural implementation, and the two major classes of processes are self-control and self-observation. Self-control processes are particularly relevant (McCormick et al., 2019). The Think-aloud methodology has revealed how athletes actively process and verbalise pain during endurance activities, with experienced athletes demonstrating qualitatively different cognitive responses to pain compared to novices (Johnson et al., 2023; Samson et al., 2017; Whitehead et al., 2018). Referring to the Metacognitive Framework for attentional focus and cognitive control (Brick et al., 2015) (see Figure 2.3), a diverse range of metacognitive strategies have been reported by endurance athletes as helpful during the performance phase (Brick et al., 2015) of the self-regulation phase. Figure 2.3 provides a visual representation of how elite runners employ these cognitive strategies across different dimensions. The framework shows the relationship between metacognitive skills (planning, monitoring, and evaluating) and metacognitive experiences (feelings of knowing, difficulty, and confidence) that inform athletes' attentional focus during performance.

**Figure 2.3**

*A Metacognitive Framework of Attentional Focus and Cognitive Control in Elite Runners (permission granted by Brick in 2025)*
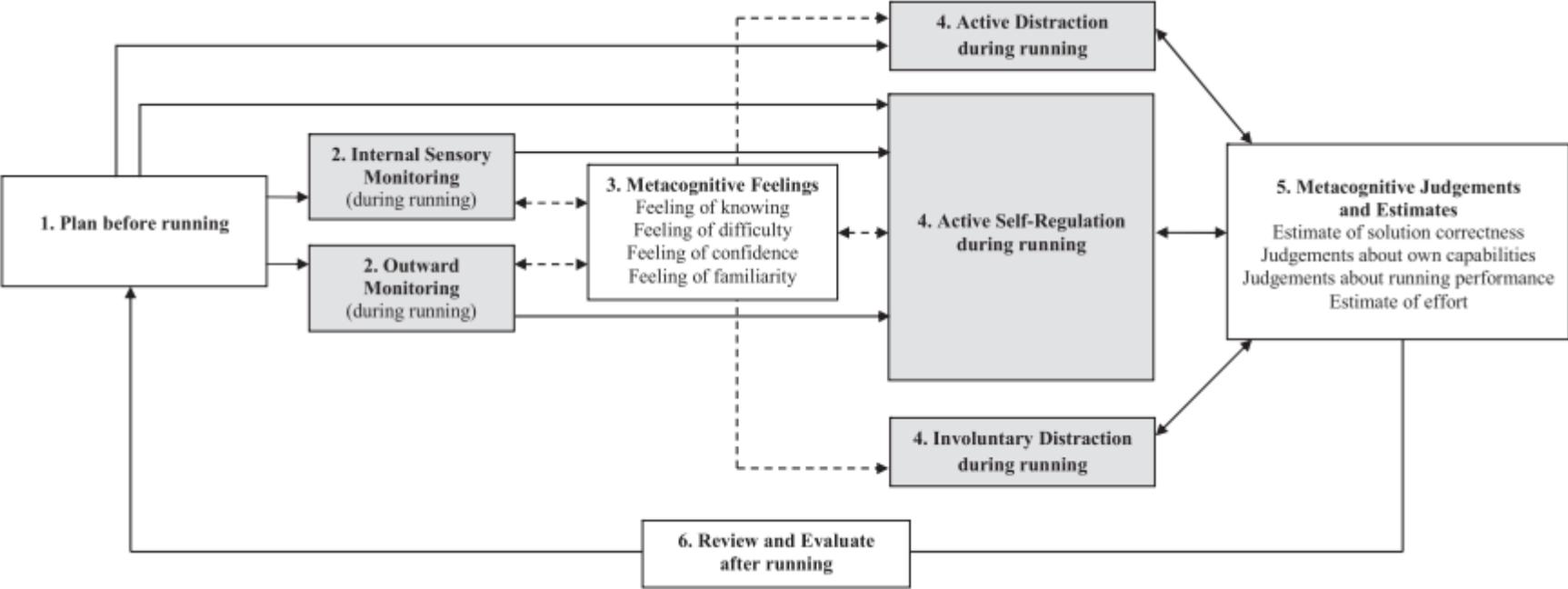
As illustrated in the figure, runners developed internal monitoring systems that allow them to shift between different attentional strategies, such as active self-regulation (focusing on form or pacing) and active distraction (chunking distance), depending on their needs at different points during a running event. This framework also explains how experienced female ultra-athletes might develop their capacity to manage pain through metacognitive processes refined over multiple competitive experiences. For example, ultra-runners have used active self-regulatory strategies of chunking and breaking down distance to cope with the demands of the event (Berger et al., 2020; Holt, 2014). In a recent study of how recreational distance runners self-regulate during optimal experiences (Jackman et al., 2021), the state of flow was facilitated by non-specific goals and involuntary distraction, while clutch states involved pursuing specific goals with active self-regulatory strategies to manage any discomfort. Taken together, these findings illustrate how different regulatory states may be associated with different experiences of pain and discomfort during endurance activities.

The self-reflection phase refers to processes that occur after the behavioural implementation. The two major classes of processes in the self-reflection phase are self-judgment and self-reaction. Self-judgments include comparisons of self-observed performances against a standard (e.g., prior performance, another person's performance), and causal attributions for success or failure. Self-satisfaction is a key form of self-reaction, and it can influence the effort that an athlete is willing to put into future activities. Post-event learning from experience and identifying effective or ineffective pain management strategies would help for future performances (Hall & Rhodes, 2024). The Metacognitive Framework (Brick et al., 2015) also aligns with this phase of self-regulation in terms of its metacognitive components: metacognitive skills (i.e., planning pain management strategies, monitoring for types and intensity of pain, and evaluating them afterwards); and metacognitive experiences

(i.e., the subjective feelings of knowing, difficulty, confidence, and familiarity) which inform future strategy selection and use during performance.

These temporal dimensions of self-regulation are particularly relevant for studying female ultra-endurance athletes' pain experiences across multiple time scales. First, immediate pain processing occurs within the neuromatrix as athletes interpret sensations during performance. Second, the cyclical phases of self-regulation capture how athletes manage pain throughout an event—from pre-race planning to mid-race adjustments to post-event evaluation. Third, experiential learning across multiple events contributes to the development of increasingly refined pain management capabilities over an athletic career. This multi-temporal perspective is essential for understanding how female ultra-athletes develop, refine, and deploy pain coping strategies, especially given potential influences of female-specific temporal factors such as menstrual cycles, pregnancy/postpartum recovery periods, and perimenopausal/menopausal transitions that may affect pain experiences differently across various time scales (Copeland & Verzosa, 2014). Examining these temporal dimensions provides insight into not just what strategies female ultra-athletes use, but how they learn which strategies work best for their individual circumstances through iterative experience.

This cyclical model of self-regulation is a process that involves an individual taking actions that require regulation of thoughts, feelings, and behaviours that the individual has influence over, while also considering what is going on in the environment (McCormick et al., 2019). This framework provides valuable insight into understanding female ultra-endurance athletes' pain experiences during their sport. Females encounter unique pain considerations such as menstrual-related pain, pregnancy/post-partum recovery, and different biomechanical stressors (Copeland & Verzosa, 2014) alongside exercise related pain. Researchers suggest female athletes may engage in more comprehensive forethought

planning related to pain management, incorporating previous experiences and anticipated challenges (Buman et al., 2008). The self-regulation framework helps explain how female athletes develop increasingly practiced approaches to pain management through experience, refining their understanding of different pain types, appropriate responses, and effective coping strategies with each ultra-event. For example, Brick et al. (2015) found that elite runners (a mixed-gender sample of 6 females and 4 males, including two ultra-distance specialists) reported using metacognitive processes to monitor and control their cognitive processes during endurance activities through active distraction and self-regulatory strategies developed from accumulated experience. While Brick's study was not specifically focused on females or ultra-distance events, their findings on metacognitive control provide a foundational understanding. Building on this, recent research by Whitehead et al. (2018) found that trained runners consciously monitored internal states (pain/discomfort) not to dwell on them, but to make informed pacing decisions. Additionally, the process of verbalising thoughts appeared to help participants maintain a more realistic pace during cycling (Whitehead et al., 2022). The studies demonstrated that verbalising thoughts about pain and effort can serve as an effective self-regulatory strategy that helps athletes process these sensations more effectively and make better pacing decisions. These findings highlight how women in ultra-endurance events may process and respond to pain through more multidimensional cognitive frameworks that consider both physiological sensations and psychosocial contexts, creating personalised pain management systems refined through competitive experience.

The integrated theoretical tenets of the Neuromatrix Theory, Self-Regulation and Social Cognitive Framework, and Metacognitive Framework, provide complementary perspectives that together create a comprehensive lens for understanding how female ultra-endurance athletes experience and manage pain using a biopsychosocial approach. There are

several key commonalities that can inform this research. Firstly, they all conceptualise pain coping management as learned from experience, as evidenced in Bandura's (1997) emphasis on how mastery experiences with pain develop pain-specific self-efficacy, Zimmerman's (2000) cyclical self-reflection phase where past pain performances inform future pain management approaches, and Brick et al.'s (2015) findings that elite athletes' metacognitive skills for pain regulation develop through accumulated painful experiences. Second, they all involve interlinked processes between emotion, cognition, behaviour and social learning; thirdly, the temporal dimensions of pain coping are recognised through the planning/ forethought, performance and reflection/evaluation phases which can infirm the thesis research; fourthly, they acknowledge that effective pain management requires appropriate strategies selected for specific contexts (e.g., distance, terrain, pain type) rather than applying one size fits all approach. They explain how athletes develop tacit understanding of which strategies work in which situations. Fifth, collectively the physiological processes interact with psychological interpretations and social contexts to shape pain experiences.

The Social Cognitive Theory, Self-Regulation Framework, and Metacognitive Framework together provide a robust foundation for examining female ultra-endurance athletes' pain experiences through a biopsychosocial lens. Social Cognitive Theory illuminates how pain management capabilities develop through direct experience, observation, and social feedback. The Self-Regulation Framework captures the temporal dimensions of pain processing across pre-event planning, in-event adjustment, and post-event reflection. The Metacognitive Framework explains how athletes develop awareness and control of their cognitive processes during pain experiences. These frameworks complement the neurobiological understanding provided by the Neuromatrix Theory by explaining the psychological and social mechanisms through which athletes actively interpret and manage pain sensations. This integrated theoretical approach informs both the research questions and

methodological approaches employed in this thesis, guiding investigation of how female ultra-athletes perceive, evaluate, manage, and learn from their pain experiences across different temporal contexts and biopsychosocial domains. Having established these theoretical foundations that explain the mechanisms of pain processing and regulation, the next section will examine how these frameworks can be applied to understand the specific manifestations of pain in ultra-endurance contexts. The following section explores the types of pain commonly experienced by ultra-endurance athletes, approaches to measuring and assessing these pain experiences, and how biological, psychological, and social factors interact in shaping pain responses during ultra-endurance events.

### 2.1.4 Sociocultural Perspectives on Pain in Endurance Sport

The integration of sociocultural frameworks - specifically the sport ethic and performance narrative, strengthens the biopsychosocial understanding of pain in this study by illuminating the social and cultural forces that shape pain experiences Although biopsychosocial models acknowledge social influences on pain, they typically emphasise individual psychological factors and proximal social support without addressing the distinctive cultural norms, institutional structures, and identity narratives operating within competitive sporting contexts that systematically shape how athletes experience and respond to pain (Howe, 2004; Roderick, 2006). An integrated approach enables examination of whether pain influences ultra-endurance participation and how cultural and narrative processes shape the meanings athletes ascribe to pain and the behavioural responses they deem legitimate within their sporting context.

**2.1.4.1 The Sport Ethic: Cultural Norms and Conformity Pressures.** The foundational concept of the sport ethic identifies four core norms defining legitimate athletic identity (Hughes & Coakley, 1991): making sacrifices for sport, striving for distinction, accepting risks and playing through pain, and refusing to accept limits in pursuit of

possibilities. Further analysis emphasises that the sport ethic operates as a structural and cultural force creating systematic pressures that reward extreme commitment, while marginalising athletes who prioritise health over performance (Coakley, 2015). Athletes develop identities through overconformity to the sport ethic, creating vulnerability to dangerous behaviours where athletes believe you can never go too far in pursuit of athletic excellence (Coker-Cranney et al., 2018). Additionally, researchers have documented athletes' conformity to the sport ethic leading to some athletes to accept experiences of psychological maltreatment. This simultaneously creates vulnerability to experiencing psychological maltreatment within sport as punishment when the athletes did not meet the standards associated with the sport ethic (McGee et al., 2024). Sporting cultures use pain tolerance as both identity marker and social control mechanism creating normalised cultures of risk where pain tolerance becomes embedded within systematic cultural processes (McGee et al., 2024; Overbye, 2021).

The normalisation of performing hurt—competing or training despite injury or pain— reflects the sport ethic's influence on athletes' health behaviours. Athletes navigate between risky behaviour (competing injured, overtraining) and self-care based on ecological factors including time pressure, medical support quality, coach relationships, and competitive level, with professional athletes paradoxically showing more conservative views about competing injured compared to amateur athletes (Schubring et al., 2023). Mayer et al.'s (2018) study of 1,138 German elite adolescent athletes (aged 14-18; 56.1% male, 43.9% female) revealed deeply internalised "cultures of risk," with 42% considering it illegitimate to rest even while taking painkillers and 16% unwilling to rest with feverish colds, representing what Coakley (2015) terms "positive deviance" where unhealthy behaviour is rewarded. Overbye's (2021) study of 775 elite athletes (41% female) confirmed widespread experience with sport-related analgesics (93%), with social pressure significantly increasing willingness to compete hurt,

particularly among team sport athletes (72%) compared to individual sport athletes (57%). Moreover, by analysing research findings across high-performance domains, Bursik et al. (2025) identified psychosocial factors influencing performing hurt, including fear of being replaced, perceived pressure from coaches and teammates, and strong athletic identity. These factors may explain how Derman (2018) highlighted how cultural slogans like "pain is weakness leaving the body" create environments where athletes minimise suffering rather than address it appropriately, necessitating holistic approaches acknowledging psychological and social dimensions alongside biological mechanisms.

Institutional structures actively reinforce sport ethic conformity such as through medical professional roles that can perpetuate cultures of risk. Researchers demonstrated that workplace organisational arrangements create conditions wherein athletes feel compelled to minimise injuries and accelerate return-to-competition timelines (Roderick, 2006), while medical professionals employed within performance-focused organisations face dual responsibilities to individual athlete welfare and team performance objectives, creating conflicts that frequently resolve in favour of organisational interests (Waddington & Roderick, 2002). These structural dynamics place athletes in positions of vulnerability when expected to assess complex health information and make informed decisions about participation despite injury (Paul et al., 2022). Hamilton (2018) argued that addressing these tensions requires clear contracts of expectations that avoid embedding medical practitioners within performance cultures that normalise excessive risk-taking. Highlighting how medical complicity systematically perpetuates sport ethic norms like particularly the expectation of playing through pain. Collectively, these researchers demonstrated how such norms are maintained through institutional relationships and power structures rather than emerging solely from athlete peer culture, revealing the sport ethic as both cultural ideology and organisational practice.

While these institutional mechanisms affect all athletes, female ultra-endurance athletes face what can be understood as double conformity. Women must demonstrate adherence to traditionally masculine-coded sport ethic values of stoicism, extreme pain tolerance, and refusing limits (Krane et al., 2004; Wellard, 2016). Simultaneously, they manage distinctly female physiological challenges such as hormonal fluctuations, menstrual cycles, sex differences in pain processing (Allen-Collinson & Jackman, 2022). McGee et al.'s (2025) identification of desire to please as a gendered socialisation pattern reveals how women's cultural conditioning toward people-pleasing intensifies vulnerability within sporting cultures that valorise extreme pain tolerance. Female ultra-endurance athletes must therefore pursue sporting legitimacy through extreme pain tolerance while operating within cultural contexts that may simultaneously question both their capabilities and dismiss their pain experiences.

**2.1.4.2 Performance Narratives: Identity Construction.** The performance narrative framework exposed how sporting cultures shape identity through stories prioritising single-minded dedication to sport and winning above all other areas of life (Douglas & Carless, 2009). When performance narratives fail, e.g., through injury, aging, or performance decline, athletes experience narrative wreckage requiring complete asylum (removal from sport culture) to develop alternative relational narratives. The framework may explain how female ultra-athletes develop pain tolerance capabilities through identity systems normalising extreme suffering as necessary for sporting legitimacy, while the concept of narrative wreckage may illuminate psychological vulnerabilities when athletes can no longer maintain extreme standards. Performance narratives create the temporal dimensions of performance narratives create challenges for young female athletes pursuing dual careers. For example, Ronkainen et al.'s (2021) phenomenological study of talented Finnish sportswomen revealed how pressed time perspectives inherent in combining high-performance sport and education

require constant self-management and temporal efficiency. They demonstrated that while some young women successfully embodied superwoman ideals through time-management skills and future-oriented achievement, others experienced these demands as unsustainable, necessitating what they termed learning not to be perfect.

The intersection of performance narratives with female identity construction creates complexity in ultra-endurance contexts, as female athletes must navigate what becomes a triple identity challenge: performing athleticism that meets extreme sporting standards, managing femininity within social contexts that may question their participation in extreme sports, and demonstrating the extraordinary pain tolerance required for ultra-endurance legitimacy. The multi-level framework developed by Karos et al. (2024) provides crucial theoretical advancement for understanding these sociological dimensions, demonstrating how gender influences pain experiences across four interconnected levels: intra-individual (embodied experiences), interpersonal (social interactions), positional (social status affecting resource access), and ideological (institutionalised gender beliefs creating systematic biases). Karos et al.'s (2024) framework demonstrated that female pain experiences cannot be understood through individual factors alone but require analysis of how gender operates as social structure across multiple levels simultaneously. They highlighted additional layers of social complexity beyond those identified in male-focused research, where traditional feminine ideals of pain avoidance and emotional expressiveness conflict directly with sporting demands for stoicism and extreme tolerance (Karos et al., 2024). Furthermore, an embodied approach provides crucial theoretical advancement for understanding how gender operates in ultra-endurance contexts (Allen-Collinson & Jackman, 2022; Allen-Collinson, 2023; Wellard, 2016).

Overall, these sociocultural perspectives complement neurobiological and psychological frameworks by explaining how cultural contexts actively shape pain

interpretation and management strategies. Rather than viewing pain as merely an individual biological or psychological phenomenon, this biopsychosocial approach recognises pain as emerging from complex interactions between all three domains. For female ultra-athletes, a sociological understanding is particularly crucial, as it explains how athletes must navigate the pursuit of recognition as authentic athletes through extreme pain tolerance while operating within cultural contexts that may question both their capabilities and their pain experiences. Equally how pain experiences are simultaneously shaped by sporting culture demands, gender performance expectations, and social navigation requirements that create distinctly complex embodied experiences acknowledging the inherently social nature of pain in ultra-endurance contexts (McGee et al., 2024, 2025).

## 2.2 Pain in Ultra-Endurance Sport

Building on these theoretical foundations, this thesis now turns to how pain specifically manifests in ultra-endurance contexts. The present-day understanding of pain as a multidimensional experience requires examining how biological mechanisms, psychological processes, and social contexts interact to shape female ultra-athletes' experiences during extended physical challenges. The IASP updates reflect the multidimensional nature of ultra-endurance pain and the advantage of adopting a biopsychosocial approach to gain a greater understanding of an individual's subjective pain experience(s) (Gatchel et al., 2007; Hainline et al., 2017; Jull, 2017; Palermo, 2020).

The three key domains of the biopsychosocial model of pain can be contextualised to ultra-endurance sports settings. First, the biological domain captures physiological responses to prolonged exertion in ultra-endurance events, including different pain types such as delayed onset muscle soreness, physical adaptation processes that develop with ultra-training, environmental impacts on pain perception during extreme events (temperature, altitude, terrain), and how neurosignature patterns can persist even after objective tissue recovery.

Second, the psychological domain encompasses cognitive strategies used for pain management and how they are developed by ultra-athletes to aid mood and emotional regulation during extreme challenges over multiple hours and days (Johnson et al., 2016), meaning-making processes that transform pain perception, and how attentional focus strategies develop through ultra-training and competition to modulate pain during ultra-events (Brick et al., 2015). Third, the social domain addresses gender-specific experiences and challenges in pain management, how social expectations influence pain expression and tolerance, and how social interactions such as training partners can influence pain perception and meaning in ultra-sports (Johnson et al., 2016).

Ultra-endurance takes place in a variety of settings, terrains, and locations which results in variations that not only affect the biomechanical, physiological, nutrition, sociological, and psychological (Best et al, 2018; Judelson et al, 2015b; McNarry et al., 2021; Roebuck et al., 2018; Schutz et al., 2012; Thorpe & Clark, 2020) demands of the chosen event, but also the strategies employed by athletes and their support crews. Pain is identified as a central performance factor in ultra endurance contexts, Berger et al. (2024) identified pain as one of several factors that systematically increase throughout ultra-events, alongside decreased cognitive function, increased gastrointestinal distress, and reduced neuromuscular capacity. They recognise pain tolerance as a differentiating characteristic between ultra-athletes and non-athletes, such as highlighting how ultra-endurance runners displayed higher pain tolerance and lower pain-related anxiety compared with non-runners. However, this comprehensive review explicitly avoided gender-specific analysis, indicating that female ultra-athletes' pain experiences remain an understudied area requiring dedicated investigation.

### 2.2.1 Types of pain.

As highlighted by the biopsychosocial theoretical explanations of pain, female ultra-endurance athletes will encounter various types of pain to be interpreted and managed for

their impact on performance during a race or in training. Being able to distinguish different types and their sensory or affective qualities is an important cognitive process for developing coping strategies based on accurate pain assessment. In general terms, pain has several valuable functions, including signaling injury or disease, and produces a wide range of protective actions, such as seeking help, avoidance behaviours, or resting to stop discomfort and treat its causes (Melzack, 2001). To distinguish between types of pain a variety of competitive ultra-athletes have reported symptoms related to exercise-induced muscle pain (EIP) which arises from increased intramuscular pressure and metabolite accumulation and is a natural consequence of intense/prolonged exercise. Although it can be a significant performance limiter, it usually resolves shortly after reducing intensity or ceasing exercise (Astokorki & Mauger, 2017; Cook et al., 1997; Mauger & Shirrefs, 2019; Pettersen et al., 2020; Schutz et al., 2012).

In addition, athletes reported exercise-associated muscle cramp (EAMC) as a temporary but intense and painful involuntary contraction of skeletal muscle occurring during, or soon after, a period of physical activity. Environmental conditions and hydration status can adversely influence EAMC which presents particularly significant challenges when experienced in remote ultra-events (Maughan & Shirrefs, 2019). Post-exercise, athletes have also reported pain associated with delayed onset muscle soreness (DOMS) following exertion, which affects training continuity and recovery, requiring careful management in multi-day events (Sullivan et al, 2000).

The last type of pain that requires attention is the ability to differentiate pain signals associated with injury (acute or chronic) from normal training/racing discomfort, critical for appropriate response and management, and is often complicated by high pain tolerance in ultra-athletes (Bolling et al., 2019; Hainline et al., 2017; Sullivan et al, 2000). Acute pain, defined as lasting less than three months, is considered adaptive (Price, 1999) whereas

subacute (pain duration approximately 6–12 weeks) nociceptive pain in sport may be associated with a range of tissue-based issues (Hainline et al., 2017). Chronic pain lasts longer than three months and is typically intractable, leading to decreased wellbeing and functional capacity (Melzack, 2001; Price, 1999).

As pain persists, the potential influence of factors within the wider biological domain (fatigue state, pelvic pain, menstrual cycle, training load, and nutrition); the psychological domain (stress, mood, pain-related appraisals, and expectations); and the social/environmental domain (e.g., responses from coach and parents, team dynamics and structure and economic implications) needs to be assessed and considered in planning treatment (Hainline et al., 2017). Elite runners highlighted that injury pain was more about the impact it had on their ability to continue at the same level of intensity and effectively compete with no impairment (Bolling et al., 2019).

During the cognitive process of ascertaining the types of pain experienced by ultra-athletes, it helps to ascertain the sensory and affective qualities, and the perceived severity of the pain intensity. Pain intensity is defined as the degree of discomfort that individuals experience when exposed to painful stimulation (Chapman, 1980). A person's pain tolerance level refers to the maximum intensity of a pain-producing stimulus that a subject is willing to accept in each situation and is a very subjective experience of the individual (IASP, 2020). Pain intensity is primarily perceptual in nature and pain tolerance is primarily behavioural in nature (Chapman, 1980). Given that pain intensity is an important determinant of activity tolerance, individuals who are better able to minimise their pain experience may be able to persist longer in pain-inducing activities (Astokorki & Mauger, 2017). This links well to Bandura's (1997) concept of self-efficacy for pain tolerance, which plays a crucial role in performance during ultra-endurance events where pain can become a significant performance limiter (Mauger et al., 2016; Pettersen et al., 2020; Schutz et al., 2012). As noted in Chapter

1, most pain researchers examining these pain types in ultra-endurance contexts have conducted their studies predominantly with male participants, with limited female sampling or no gender-specific analysis in mixed sampling, highlighting the need for female-focused investigation.

## 2.2.2 Pain measurement

Pain qualities, such as intensity, time, duration, and type, are assessed using self-report scales, observation techniques, and physiological measures. Self-report scales range from visual analogue scales, verbal numerical scales and verbal descriptive scales (Jensen et al., 1994; Joyce et al., 1975; Price et al., 1994; Tait et al., 1990; Walsh & Leber, 1983) and structured interviews or questionnaires, such as the McGill Pain Questionnaire (Melzack, 1975, 1987). Observational methods used in research studies include recording variables such as time spent resting, medication use, sleep patterns, and verbal/motor 'pain behaviour (Payne & Horn, 1997). Two inventory tools that are pertinent for the use in this thesis and have proved relevant in assessing pain in sporting and exercise context, are the McGill Pain Questionnaire Short Form (SF-MPQ 2) (Melzack, 1987) and the Sport Inventory for Pain (SIP: Meyers et al., 1992).

The McGill questionnaire is a multidimensional measure of pain quality. In the short form there are 15 representative words for the athlete to choose: 11 sensory and 4 affective, ranked 0 ('none') to 3 ('severe') for the intensity scale. There is also a Present Pain Intensity (PPI), a VAS, and a body map for locating the pain. This guide helps participants think about their current pain experiences and reflecting on the nature and intensity of it. Researchers have demonstrated the SF-MPQ has acceptable reliability and predictive validity in previous research (Wright et al., 2001). In a recent study (Boat et al., 2021), participants' perceptions of pain, perceived motivation to continue with a cycling time-trial, and perceived task importance were measured using Visual Analog Scales (VAS), adapted from the short-form

McGill pain questionnaire (SF-MPQ; Melzack, 1987). The researchers used this approach to capture both pain intensity and qualitative aspects of the pain experience during physical exertion. In brief, the VAS consisted of a 10 cm line, and participants were asked to indicate their current perception of pain by making a mark on the line. At either end of the 10 cm line were anchors (pain: 'no pain' to 'worst pain possible'. Whereas for a wall-sit task (Boat & Taylor, 2017), the participants were asked to note their sensations on a four-point scale anchored by 0 (none) to 3 (severe). Four items each from the sensory ("Throbbing", "hot-burning", "cramping", "aching") and affective ("Tiring-exhausting", "sickening", "fearful", "punishing-cruel") subscales. This was in addition to the VAS 10cm line. This demonstrated its utility for collecting pain data from ultra-athletes.

The Sport Inventory for Pain (SIP) (Meyers et al., 1992) has been used as a predicting tool for the athlete's capacity to cope with pain (e.g., race-induced muscular pain, exertional pain, or injury-related pain). The SIP is a 25-item sport-specific instrument which measures five subscales relevant to competition: direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al., 1992). There is also a total coping response (TCR) score (TCR = COP + COG - CAT), which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain. In a recent study (Parkins et al., 2024), researchers used the SIP to quantify the coping skills of 161 female ultra runners, demonstrating its effectiveness for assessing pain coping strategies in this specific population.

With an understanding of the various types of pain encountered in ultra-endurance contexts and their measurement approaches, the next section will examine how biological, psychological, and social factors interact to shape athletes' experiences of these pain types, with particular attention to research findings relevant to female ultra-athletes.

### *2.2.3 Biopsychosocial perspectives on pain in ultra-endurance sport*

While the section is organised according to the three domains of the biopsychosocial model for clarity, these domains are fundamentally interconnected—biological processes influence and are influenced by psychological strategies, which are themselves shaped by and expressed within social contexts. This interconnectedness becomes particularly evident when examining female athletes' experiences, where biological factors (hormonal cycles, pregnancy), psychological processes (cognitive reappraisal, coping strategies), and social contexts (gender expectations, medical dismissal patterns) interact simultaneously and inseparably. As established in section 1.3.2, pain researchers systematically underrepresent female participants. The following subsections review through a biopsychosocial framework, current sport-specific research within each domain, before synthesising their integration in the context of identified research limitations (section 2.3).

**Biological Domain.** Researchers examining physiological aspects of pain in ultra-endurance contexts have identified several key biological mechanisms and considerations. Under research relating to pain sensitivity and tolerance, field studies observed greater performance in ultra-endurance sport athletes with higher pain tolerance (Schutz et al., 2012; Freund et al., 2013). However, this research predominantly focused on male participants, and the testing of tolerance was not while running but in relation to experimental cold pain testing in a mobile testing unit. Similarly, in a study comparing endurance and strength athletes, Assa et al. (2019) demonstrated that while both athlete groups had lower pain ratings than non-athletes, endurance athletes exhibited higher heat-pain tolerance and stronger conditioned pain modulation than strength athletes, along with lower fear of pain levels. These findings suggest that prolonged exposure to pain during endurance training develops specific tolerance capabilities.

In studies that examined hormonal influences on pain experience, the female-specific hormonal complexity remains limited. Although Copeland and Verzosa (2014) identified

menstrual cycle influences, studies have not adequately examined how hormonal fluctuations across the female lifespan, from puberty through to perimenopause and menopause, may affect pain experiences in female ultra-endurance contexts. This represents an important biological dimension that likely interacts with psychological and social aspects of pain experience, although comprehensive investigation of these hormonal influences falls outside the scope of this thesis.

Some researchers have investigated physiological interventions for pain management in endurance contexts. For example, researchers have investigated transcutaneous electrical nerve stimulation (TENS) potential for improving endurance performance by reducing exercise-induced pain (Astokorki & Mauger, 2017). Similarly, virtual reality interventions demonstrate promise for managing exercise-induced pain by modulating physiological responses (Matsangidou et al., 2019). However, these studies typically include female participants without conducting gender-specific analyses, missing opportunities to identify potential sex differences in pain modulation mechanisms. In general, there is a consistent limitation across physiological studies due to the lack of gender-specific analysis even when female participants are included. Additionally, most laboratory studies employ brief exercise protocols (20-60 minutes) with non-ultra-endurance participants (Astokorki & Mauger, 2017; Matsangidou et al., 2019), failing to capture the unique physiological challenges of extended ultra-events lasting many hours or days.

Researchers examining physiological responses during ultra-endurance activities reveal potential gender-specific patterns relevant to pain experiences. Loftin et al. (2009) investigated physiological responses during a 161-km ultra-marathon, finding that while male participants demonstrated higher absolute performance measures, female participants showed more efficient substrate utilisation patterns and different cardiovascular responses during prolonged exertion. These physiological differences may influence how female athletes

experience and respond to exercise-induced pain during ultra-events. Female participants maintained more stable physiological profiles throughout the extended event, suggesting potential advantages in managing the cumulative stress of ultra-endurance competition. However, Loftin et al. (2009) acknowledged that their study did not specifically examine pain responses or coping strategies, representing a significant gap in understanding how these physiological differences translate into subjective pain experiences and management approaches. These physiological findings, while foundational, cannot fully explain pain experiences in ultra-endurance contexts. Pain perception and management are fundamentally shaped by psychological processes and social contexts, examined in the following sections.

**Psychological Domain.** The psychological dimension must be understood within the broader framework of gendered psychological processes discussed in Chapter 1, as well as in relationship to the biological mechanisms examined in the previous section. Researchers demonstrate that women show different pain catastrophising patterns, utilise distinct coping mechanisms, and demonstrate varied responses to pain interventions compared to men (Keogh et al., 2024). Sport psychology scholars elucidate cognitive and emotional processes that ultra-endurance athletes employ to manage pain. During an ultra-endurance event, athletes need to stay in control of themselves and their energies to optimise their performance alongside managing the challenging demands of the event, including pain (McCormick et al., 2018b; Tuffey, 2000). Such demands differ contextualised to the whole range of ultra-endurance events (e.g., single or multi-day) and sports (e.g., open water swimming, triathlon, adventure racing or trail marathons), but have common stressors such as exercise induced muscle pain or cramp, mental and physical fatigue, sleep deprivation, musculoskeletal injuries, and competitive suffering from not reaching a goal, as well as other psychosocial demands (Evans et al., 2014; McCormick et al., 2018b; Roebuck et al., 2018).

Building on these foundational understandings of psychological demands, researchers identified key psychological traits associated with successful ultra-endurance performance, including persistence, awareness/perspective, and ability to manage physical fatigue and pain (Jaeschke et al., 2016; Roebuck et al., 2018). These psychological components appear particularly relevant for the self-efficacy link with pain tolerance of the complex pain experiences encountered during ultra-events, though gender differences in these traits remain underexplored.

In relation to cognitive appraisal and pain processing experiences athletes have demonstrated cognitive processing of pain sensations and developed tacit abilities to accurately appraise pain, accept discomfort as essential to goal achievement, and modify strategies in response to different pain types (Bluhm & Ravn, 2022; Johnson et al., 2023; Whitehead et al., 2018). Researchers have highlighted how some elite runners had specifically developed three distinct pain handling strategies of cultivating pain familiarity, shuffling with pain rather than fighting against it, and context-dependent meaning-making that assigned different interpretations to similar physical sensations based on race context and stage of route (Bluhm & Ravn, 2022). Hatzigeorgiadis et al. (2018) demonstrated how motivational self-talk helped participants maintain steady power output during a 30-minute cycling trial in hot conditions, with the self-talk group producing greater power during the final third of the trial compared to controls. This finding suggests that psychological strategies can effectively modulate pain perception, allowing athletes to maintain performance despite challenging conditions.

The use of attentional focus strategies has been reported to be important for influencing pain perception and management. Building on earlier dichotomous models of association and dissociation (Morgan & Pollock, 1977, 1987), researchers explored how these were used for coping with the demands of endurance running to manage their discomfort or

pain while performing (Phillipe & Seiler, 2005; Silva & Appelbaum, 1989; Tammen, 1996; Van Raalte et al., 2015). For example, associative tactics included concentration/focusing, use of mental imagery, and engaging in self-talk. Whereas dissociative (distraction from discomfort) tactics would be singing a specific song to oneself, engaging in distracting self-talk, and the use of imagery of task-irrelevant people, places, or events (Tuffey, 2000).

However, the approaches to attentional control during endurance performance were advanced by Brick et al. (2015) who identified elite runners using active distraction strategies that enhanced tolerating the physical exertion of competition and training. These strategies made running feel easy by counting and chunking distances together to maintain a present focus, and to break down perceived challenges. Furthermore, athletes used active self-regulatory strategies for monitoring the body and mind to enhance performance, such as relaxing during running (Brick et al., 2015). The athletes linked monitoring their bodies and surroundings through their active self-regulation and pacing, through learned experience and effective decision-making. The more skilled athletes were better adept at successfully implementing the right pacing strategy for them (Brick et al., 2015; Simpson et al., 2014). These findings align with Latinjak et al.'s (2016) goal-directed self-talk interventions, which helped athletes address specific problematic situations during competition, including pain management. Further research has also found that focusing on core components of action (internal but functional focus) and external associative strategies (focusing on pacing) benefit performance, while dysfunctional internal focus on muscle exertion/pain leads to poorer outcomes (Di Fronso et al., 2018; Samson et al., 2017).

Self-talk emerges as a particularly valuable psychological strategy across multiple studies. Adventure racing athletes and orienteers reported using self-talk to assist with managing risk and pain demands (Macquet et al., 2012; Schneider et al., 2007). Olympic cyclists recounted using positive self-talk during rides to lessen pain intensity (Kress &

Statler, 2007), while elite marathoners' self-talk was reported as 43% positive/motivational (Van Raalte et al., 2015). In addition to attentional focus as a strategy, a variety of adventure racing (a multisport, primarily off-road, navigation-based sport) and orienteering athletes found it beneficial to use self-talk to assist with managing risk and pain demands (Macquet et al., 2012; Schneider et al., 2007). Self-talk has been reported to increase the awareness of physiological states and physical performance (St Clair Gibson & Foster, 2007) and enhance proactive thoughts on performance related information such as pain (Baker et al., 2005) using task relevant statements (Rushall et al., 1988). Empirical and experimental research provides strong evidence for self-talk effectiveness in pain management, such as goal-directed and motivational self-talk helping maintain performance during thermal stress and problematic situations during competition, as well as for coping with exertion and pain from blisters and injuries (Hatzigeorgiadis et al., 2018; Latinjak et al., 2016; McCormick et al., 2018a).

Building on the benefits of self-talk to ameliorate pain and discomfort, an important methodological development in understanding athletes' cognitive processes during endurance events is the recent development of real-time cognition research through the think-aloud methodology which has been effective to reveal how athletes actively process and verbalise pain during endurance activities, with experienced athletes demonstrating qualitatively different cognitive responses to pain compared to novices (Johnson et al., 2023; Samson et al., 2017; Whitehead et al., 2018). This research specifically notes gender differences in cognitive processes, with female runners more likely to engage in personal problem solving' during marathon training, though without further investigation of these differences (Whitehead et al., 2018). This exciting development in capturing runner's cognitive processes of pain warrants further exploration in a naturalistic setting with genuine ultra-athletes competing in an event.

In terms of coping and emotion regulation, researchers have shown that both problem-focused and emotion-focused coping increase during competitive suffering, with emotion-focused strategies showing the strongest relationship with managing negative feelings (Evans et al., 2014). Cognitive reappraisal, which involves changing one's interpretation of a situation or sensation, specifically demonstrates effectiveness for managing physical stress during endurance exercise (Giles et al., 2018). These studies highlighted the importance of flexible coping repertoires but rarely examine potential gender differences in strategy selection or effectiveness. While these psychological strategies demonstrate athletes' cognitive agency in pain management, their development and deployment cannot be understood separately from the social and cultural contexts in which athletes train and compete. The cognitive strategies examined above—self-talk, attentional focus, cognitive reappraisal—are not individually invented but socially learned through peer interactions, coaching relationships, and immersion within sporting cultures. Moreover, which psychological strategies athletes learn, value, and employ are fundamentally shaped by broader cultural narratives about pain, gender-specific expectations about appropriate responses to suffering, and power dynamics within medical and sporting systems. The following section examines how sporting cultures, gender expectations, and social relationships fundamentally shape pain experiences and management strategies, revealing that psychological processes cannot be separated from their social contexts.

**Social Domain.** Social and cultural context can shape endurance pain experiences beyond individual biological and psychological factors. Understanding the sociocultural domain is particularly crucial for female ultra-athletes who must navigate not only ultra-endurance sporting cultures but also complex gendered expectations about pain tolerance, athletic capability, and appropriate feminine responses to suffering.

A striking consistency across sociological studies is the identification of distinct pain categories that athletes learn to differentiate through social processes rather than discovering pain through individual experience alone (Hanold, 2010; Lev, 2019, 2021; McNarry et al., 2020; Throsby, 2013). Endurance athletes learn to value general discomfort and muscle soreness as signifiers of effective training while actively avoiding sharp alarming sensations signalling injury risk that may threaten training continuity and athletic identity (McNarry et al., 2020). The ultra-endurance community creates distinctive social environments facilitating this learning, with researchers highlighting the supportive, non-judgmental nature of ultrarunning culture that creates space for diverse body types and experiences while enabling knowledge exchange about pain management strategies (Hanold, 2010; Simpson et al., 2014).

Athletes develop pain classification as socially transmitted competence rather than innate physiological sensitivity, with pain and discomfort becoming normalised within endurance cultures where stoicism and willingness to endure are valorised as markers of athletic identity (Allen-Collinson & Jackman, 2022; Lev, 2019; McNarry et al., 2020; Throsby, 2013). Endurance pain is learned and contingent, not innate, requiring active re-learning after injury, illness, extended breaks, or life transitions such as pregnancy, with athletes drawing upon embodied memories of previous experiences and mental reframing strategies to navigate the intertwined experiences of fatigue and pain (Allen-Collinson & Jackman, 2022).

This socially learned pain literacy develops through sequential developmental stages. Lev's (2019) three-year ethnography of recreational distance runners revealed that even the celebrated runner's high requires three stages of social learning rather than constituting automatic physiological response. Athletes must first learn proper technique, then recognise pain signals and connect them to specific activities and finally reframe unpleasant sensations as positive through cognitive restructuring and peer validation. Management of pain involves

continuous monitoring during activity, with athletes constantly assessing bodily states and adjusting effort levels accordingly, while social sharing of pain experiences with co-runners and broader endurance communities provides crucial validation and normalisation of suffering (Lev, 2019; McNarry et al., 2020). Lev's (2019) findings demonstrate pain as a fundamentally social phenomenon shaped through collective sense-making rather than purely individual experience.

For female ultra-athletes, this social learning process carries additional complexity as women must develop not only physiological pain tolerance but also cultural competence to interpret and categorise pain appropriately within sporting communities. Women simultaneously navigate medical and social contexts characterised by systematic gendered pain dismissal where their pain is frequently psychologised, minimised, or attributed to emotional sensitivity rather than legitimate physiological distress (Samulowitz et al., 2018). Allen-Collinson and Jackman (2022) highlight that menstrual pain management, post-pregnancy recovery, and perimenopausal symptoms constitute corporeal and cognitive labour performed alongside visible training and competition pain. When women and men complete identical training loads, women may perform substantially more total labour managing both training pain and menstrual pain simultaneously, yet this layer often remains unrecognised with menstrual pain dismissed as normal female experience not warranting accommodation. Female runners develop sophisticated classification systems differentiating between running niggles, menstrual pain requiring specific management, and serious injuries, with some female ultra-athletes explicitly connecting current pain experiences to previous pregnancy and weight fluctuations, revealing gender-specific relationships with embodiment where women's pain cannot be separated from broader embodied histories (Hall & Rhodes, 2024).

These gender-specific dimensions intersect with broader challenges to conventional endurance narratives. Throsby (2013) explicitly challenged the mind-over-matter narrative,

critiquing this as an overly masculine and reductive framework that misrepresents how endurance mechanisms function. Bodily suffering in marathon swimming includes cold exposure, cramps, nausea, seasickness, and prolonged discomfort, with pain creating dys-appearance moments wherein the body becomes obstacle during episodes of acute distress. Endurance is not merely about overcoming pain through mental toughness but involves sensory adaptation through development of a shifted sensorium including enhanced kinaesthetic awareness and thermoception enabling swimmers to interpret bodily signals in extreme conditions such as hypothermia risk. This analysis positions embodied sensory transformation rather than cognitive override as the primary mechanism enabling sustained ultra-endurance performance, thereby challenging masculine-coded valorisation of willpower and mental dominance over bodily distress.

The social dimensions of pain extend beyond peer learning to encompass institutional power dynamics that shape which pain interpretations are legitimised. Lev's (2021) analysis revealed how physiotherapists exercise considerable institutional power over athletes' pain interpretation through gatekeeping access to alternative healthcare providers, educating athletes which pain types warrant concern versus which can be worked through, employing painful treatments framed as necessary, and rarely having interpretations challenged by athletes displaying docility in clinical contexts. This professional control operates through subjectivation whereby athletes become subject to biomedical discourse and construct pain identities according to categories named by medical authority, with athletes' embodied knowledge becoming subordinated to professional expertise (Lev, 2021).

For female ultra-athletes, professional power intersects problematically with gendered pain dismissal patterns, creating conditions whereby women must demonstrate extreme pain tolerance to gain athletic legitimacy while navigating medical contexts that may simultaneously dismiss legitimate concerns (Samulowitz et al., 2018). Furthermore, clinical

researchers have highlighted problematic aspects of pain culture in athletics more broadly, noting the romanticization of pain ("pain is weakness leaving the body" mentality) that creates environments where athletes minimise suffering rather than address it appropriately, necessitating more holistic pain management approaches (Derman, 2018).

The sociological evidence demonstrates that pain in ultra-endurance contexts is socially constructed yet materially real and operates simultaneously as discipline and empowerment. It requires continuous active work rather than constituting permanent achievement; it is fundamentally intersubjective and socially produced rather than purely individual experience and deeply gendered with women navigating female-specific pain experiences alongside systematic gendered dismissal (Allen-Collinson & Jackman, 2022; Hanold, 2010; Throsby, 2013). Pain becomes central to ultra-endurance identity with athletes developing somatic expertise to interpret and manage suffering, while gender shapes pain narratives as women negotiate layers beyond general endurance demands including menstrual pain and social expectations around caring responsibilities (Allen-Collinson & Jackman, 2022; Throsby, 2013). Critically, both Allen-Collinson and Jackman (2022) and Throsby (2013) critique universalist, masculine ideals of endurance, highlighting instead the contingency, learning, and embodied sensory adaptation required for sustained ultra-endurance participation. This complexity—encompassing voluntary pain seeking, gendered pain dismissal, female-specific embodied experiences, and medical power dynamics—necessitates integrated analytical frameworks capable of examining biological, psychological, and social dimensions simultaneously.

Although some studies have employed female-only sampling (Hanold, 2010), gender analysis gaps persist with most mixed-gender studies not systematically analysing gender differences in pain socialisation, coping strategies, or identity construction. The reviewed literature demonstrates that while existing sociological research provides valuable insights

into pain's sociocultural dimensions, substantial scope remains for examining female ultra-athletes' pain experiences using an integrated biopsychosocial lens. Such examination is essential for gaining multidimensional understanding of the unique pain experiences, social learning processes, gendered embodiment challenges, and coping strategies evident in the literature, while extending investigation to include ultra-distance contexts, diverse participant populations, and longitudinal trajectories currently absent from the sociological canon. This establishes the rationale for this thesis's integrated biopsychosocial lens employing a mixed methods design capable of capturing the integrated, multidimensional reality of female ultra-athletes' pain experiences.

## 2.3 Theoretical and empirical limitations in current research

A critical synthesis of current research reveals significant gaps in understanding female ultra-endurance athletes' pain experiences. This review has identified five major gaps in current understanding of female ultra-endurance athletes' pain experiences. First, limited integration of biopsychosocial perspectives where most studies examine pain through isolated disciplinary lenses rather than integrating biological, psychological, and social dimensions. Second, an underrepresentation of female participants where female athletes are consistently underrepresented in research samples, and gender-specific analyses are often lacking even when women are included. Third, methodological limitations highlight that laboratory studies fail to capture the complexity of pain in actual ultra-events, and few studies effectively combine quantitative and qualitative approaches. Fourth, the is limited ecological validity as many studies use non-ultra-endurance participants in brief exercise protocols, failing to capture the unique challenges of events lasting 6+ hours. Lastly, there is insufficient temporal perspective: as research rarely examines how pain experiences and management strategies evolve over time, from immediate processing to long-term development. These limitations span methodological approaches, population representation, and theoretical frameworks,

creating a compelling rationale for more comprehensive research. While the theoretical

frameworks discussed in section 2.1.2-2.1.3 provide valuable lenses for examining pain in

ultra-endurance contexts through a biopsychosocial lens, the current research has not

considered this integration, especially regarding the female ultra-athlete. The following

sections outline these limitations in more detail.

First, limited integration of biopsychosocial perspectives. Most studies examine pain

through isolated disciplinary perspectives rather than integrating biological, psychological,

and social dimensions. For example, physiological studies like Freund et al. (2013) and

Astokorki and Mauger (2017) focus primarily on biological mechanisms of pain, while

sociological studies like Hanold (2010) and Lev (2019, 2021) emphasise social and cultural

dimensions without integrating physiological data. Researchers have rarely attempted to

integrate multiple theoretical frameworks to create comprehensive understanding. While each

framework offers valuable insights, their integration would provide a more differentiated and

holistic understanding of how physiological processes (neuromatrix), psychological

regulation (self-regulation), and social learning (social cognitive) interact in female ultra-

athletes' pain experiences. Many studies reduce pain to either a physiological sensation, a

psychological experience, or a social construction rather than acknowledging its inherently

multidimensional nature. This reductionism contradicts modern understanding of pain as

involving sensory-discriminative, motivational-affective, and cognitive-evaluative

dimensions (Melzack, 2001).

Researchers have not adequately explored how biological factors (hormonal

fluctuations, physical differences), psychological processes (cognitive strategies, emotional

responses), and social dimensions (gender expectations, community support) might be

experienced differently for female ultra-athletes compared to male counterparts. Additionally,

theoretical frameworks rarely achieve true integration. While some studies, such as Holt et al.

(2014), explicitly used a biopsychosocial framework, most research examines either biological, psychological, OR social dimensions rather than their integration. Despite growing recognition of pain's complexity, theoretical frameworks rarely integrate multidimensional approaches. Whitton et al. (2020) identified the need to examine whether mental toughness resources function synergistically or independently in affecting pain experiences, yet this theoretical question remains largely unaddressed, particularly for female athletes.

Second, methodological limitations. Researchers acknowledge that laboratory studies may not accurately reflect the complex pain experiences encountered in actual ultra-events (Di Fronso et al., 2018; Evans et al., 2014). Whitehead et al. (2018) specifically noted differences in cognitive processes between lab and field settings. Additionally, experimental, field-based pain studies often employ arbitrary pain stimuli that may not reflect the specific types of pain encountered in sport contexts, limiting ecological validity (Freund et al., 2013; Schutz et al., 2012; Whitton et al., 2020). Few studies effectively combine quantitative measures of pain with qualitative explorations of lived experiences. Most either focus on measurable aspects of pain (Astokorki & Mauger, 2017; Matsangidou et al., 2019) or phenomenological dimensions (Lev, 2019, 2021; Hall & Rhodes, 2024) without integrating these approaches. As noted by Hall and Rhodes (2024) and Jaeschke et al. (2016), there is a significant lack of longitudinal studies examining how pain experiences and coping strategies evolve throughout athletes' careers and lifespans.

Third, underrepresentation of female participants. Despite the growing literature on ultra-endurance athletes, a systematic examination reveals the extent of female underrepresentation in ultra-endurance pain research. For example, Berger et al. (2024) explicitly stated they would not address sex differences in their interdisciplinary analysis of ultra-endurance performance, despite identifying pain tolerance as a key distinguishing

characteristic of ultra-athletes. This pattern reflects broader gender gaps in sport science research and indicates that female athletes remain significantly underrepresented across multiple sport science disciplines. Research on ultra-endurance pain experiences is characterised by significant population limitations that particularly affect our understanding of female athletes. Across the reviewed studies, female participants were consistently underrepresented. For example, Remilly et al. (2023) included only 26.3% female participants, Di Fronso et al. (2018) included only four women out of eleven participants, McCormick et al. (2018a) included 25 males and 4 females, and Samson et al. (2017) included just four women out of ten participants. Some studies included no female participants at all (Freund et al., 2013; Hatzigeorgiadis et al., 2018; Latinjak et al., 2016.). Even when female participants were included, many studies failed to analyse results by gender. For instance, Astokorki and Mauger (2017) included female participants but did not examine gender-specific responses to pain interventions. Similarly, Simpson et al. (2014) did not analyse gender-specific experiences of ultramarathon participation. As acknowledged by Hall and Rhodes (2024), many studies rely on samples with limited diversity. This underrepresentation reflects broader systematic patterns of exclusion in pain research. Clinical pain researchers have predominantly focused on male human participants, due to concerns about female hormonal fluctuations during menstrual cycles and potential pregnancy (Mogil et al., 2024). This has created the gaps in understanding female-specific pain mechanisms and subsequent 'biased literature' that fails to capture female-specific pain mechanisms and experiences at both human and basic science levels (Mogil et al., 2024).

Fourth, limited ecological validity. A significant methodological limitation is the inconsistent use of actual ultra-endurance athletes as participants. Many studies draw conclusions about ultra-endurance pain using participants with no ultra-endurance experience, including Di Fronso et al. (2018), Samson et al. (2017), and Matsangidou et al.

(2019). Laboratory studies typically examined shorter-duration exertion (20-60 minutes), failing to capture the unique challenges of ultra-events lasting 6+ hours. This sampling discrepancy limits ecological validity, as laboratory-induced discomfort during brief exercise differs from the complex, evolving pain experiences during actual ultra-events. Additionally, most research focuses on ultrarunning, with limited attention to other ultra-endurance disciplines like ultra-cycling, ultra-swimming, or multi-sport events. This narrow focus limits our understanding of how different physical demands might influence female athletes' pain experiences across disciplines (Hainline et al., 2017).

Lastly, there is an insufficient temporal perspective. Studies rarely integrate multiple time scales in examining pain experiences, failing to connect immediate pain processing (e.g., Neuromatrix Theory), during competition (e.g., Self-Regulation Theory), and experiential learning over time (e.g., metacognitive feelings). This multi-temporal research gap limits our understanding of how female ultra-athletes develop and practice pain management over time. The lack of longitudinal research prevents understanding how pain experiences and coping strategies may evolve throughout an athlete's career and in response to various life stages and transitions that are particularly relevant to female athletes.

Given the multidimensional and context-specific nature of these experiences, this thesis examines how female ultra-athletes develop and employ self-regulatory and cognitive strategies for pain management across different temporal dimensions (before, during, and after events, as well as throughout their athletic careers). As Temme and Hoch (2013) emphasise, evidence-based approaches specific to female athletes remain limited across coaching practices, training program design, and medical support systems, a gap this research aims to address through its integrated theoretical approach and mixed-methods design.

### 2.3.1 Rationale for the thesis

Based on the identified gaps in current research, the aim of this thesis is to advance the knowledge and understanding of female ultra-endurance athletes' pain experiences and coping. To do this an integrated theoretical approach and biopsychosocial lens has been chosen alongside a mixed methods design, combining quantitative measurement and qualitative data for a more holistic and comprehensive understanding of pain experiences.

A mixed methods approach is particularly appropriate for studying female ultra-athletes' pain experiences given the multidimensional nature of pain described in the Neuromatrix Theory and biopsychosocial framework. This mixed methods design aligns with the pragmatic worldview established in Chapter 1, recognising that complex phenomena like ultra-endurance pain require multiple investigative approaches within a pluralist ontological framework. Quantitative methods can capture measurable aspects of pain intensity, physiological responses, and performance outcomes, providing data on biological dimensions of pain. However, the subjective, context-dependent nature of pain, such as its affective and cognitive-evaluative components, also requires qualitative approaches that can access lived experiences, meaning-making processes, and sociocultural contexts. Neither approach alone can fully capture the complex interplay between biological, psychological, and social factors that shape female ultra-athletes' pain experiences. Integration of quantitative and qualitative methods enables triangulation of findings, allowing for more comprehensive understanding of both generalisable patterns and individual variations in pain experiences and management strategies (Cresswell & Cresswell, 2020; Yin, 2018). This mixed method design aligns with modern pain science's recognition that pain is simultaneously a neurophysiological event, a subjective experience, and a socially situated phenomenon (IASP, 2020).

### 2.3.2 Research Questions

This thesis addresses three primary research questions that result from these identified gaps:

1. How do female ultra-endurance athletes perceive, evaluate, and make sense of their embodied lived pain experiences? (QUAL)

2. How does reflecting and learning from experience inform female ultra-endurance athlete's future participation and performance, pain experiences, and choice of coping strategies? (QUAL+QUANT)

3. Which biopsychosocial factors influence how female ultra-endurance athletes interpret their overall pain experiences and coping strategies? (QUAL + quant)

These questions aim to advance understanding of female ultra-athletes' pain experiences through the integration of biological, psychological, and social perspectives. It will address the temporal aspects of pain experience and management by examining the retrospective, longitudinal to observe experiential learning and real-time pain experiences, within a mixed methods design. The sampling will include female ultra-athletes from a variety of ultra-endurance sports and contexts, as well as a range of competition level to gain more insights.

As Hainline et al. (2017) emphasise, pain is a personal experience influenced by neurophysiological, cognitive, affective, and social factors. Understanding the dynamic interplay of these factors specifically within female ultra-endurance populations represents a critical advancement in both pain and sport performance research.

**2.4 Research approach**

This research will employ a multi-phase mixed methods design (see Figure 2.4) to examine female ultra-endurance athletes' pain experiences across different temporal contexts. This multi-phase design operationalises the temporal ontology discussed in Chapter 1, recognising that pain experiences unfold through time within dynamic, interconnected systems where meanings evolve. As depicted in Figure 2.4, the research structure integrates three complementary studies that capture different temporal dimensions of pain experiences

and the sequential relationship between studies. The figure illustrates how findings from each phase inform subsequent investigations, creating an integrated approach to understanding the complex, multidimensional nature of female ultra-athletes' pain experiences. The integration of multiple methods will allow for a more comprehensive understanding of the complex, multidimensional nature of pain in ultra-endurance contexts than could be achieved through any single methodology. This complementarity ensures that method selection serves the research questions rather than being constrained by methodological orthodoxy. The mixed method approach will directly address identified gaps in current research by examining biological, psychological, and social dimensions simultaneously while capturing pain experiences across different timeframes. A multi-dimensional approach will capture both the immediate reality of pain during competition and the longer-term processes through which athletes learn to interpret and respond to pain experiences.

**Figure 2.4**

*A Multi-Phase Mixed Methods Research Design*
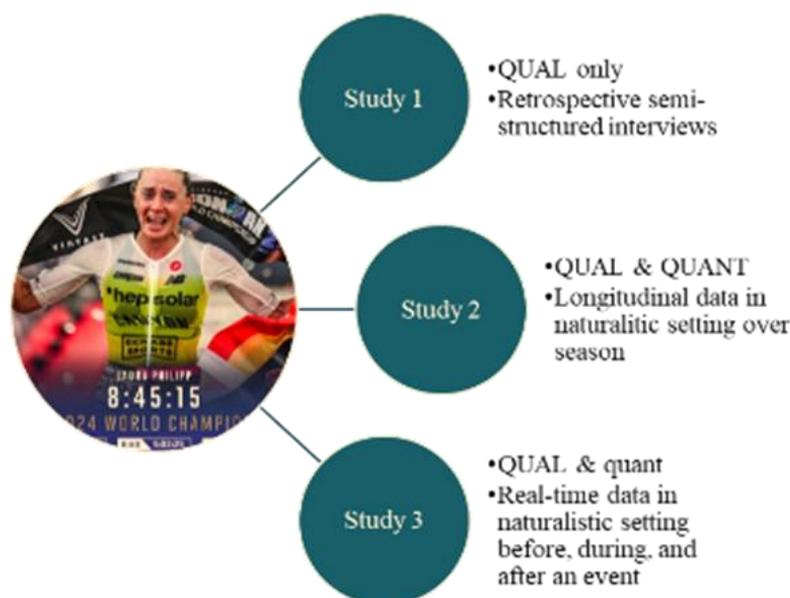


The research will comprise three distinct but complementary studies, each designed to illuminate different aspects of female ultra-athletes' pain experiences while building upon a

pragmatic, pluralistic framework. The institutional ethical approval forms for the three studies are in Appendices A.1-A.3.

**2.5 Ethical Considerations in Pain Research**

Psychologists face ethical issues in pain assessment, management, and research which are significant and numerous. There are values and ethical principles that underlie most of the standards adopted by professional organisations which are informed by influential philosophical perspectives relating to ethics such as deontology (the need to abide by principles) and teleology (emphasises the consequences of one's actions). (Hadjistavropoulos, 2012). A third relevant perspective of ethics of care is concerned with human relationships where empathy to pain and suffering are important (Hadjistavropoulos, 2012). The relevance of these perspectives is to ensure the welfare and safety of participants during pain research studies such as during this thesis. Specifically, adopting tenets of fundamental deontological principles (Beauchamp & Childress, 2019), the principles of beneficence and non-maleficence are relevant to consider during data collection. Beneficence requires preventing harm and promoting participant welfare, while non-maleficence requires weighing the benefits against burdens of pain research. Thus, these standards and codes of ethics set a foundation for researchers to abide by during data collection and analysis (Hadjistavropoulos, 2012). Ethical standards are adopted by IASP and BPS following similar codes and philosophical perspectives (BPS, 2021; IASP, 2020). Due to the researcher's positionality as a sports therapist, the codes of ethics surrounding confidentiality and participant welfare regarding pain and suffering are ingrained from previous work experiences. In addition, the teaching background informed the risk assessment process and adherence to ensure that all hazards and risks were considered during pilot stages and data collection.

Researching pain experiences in ultra-endurance contexts presents unique ethical challenges that require careful consideration beyond standard research protocols (Beauchamp & Childress, 2019). Unlike laboratory-based pain research where conditions are controlled and participant vulnerability can be anticipated, ultra-endurance research occurs in dynamic, unpredictable environments where athletes' physical and psychological states fluctuate considerably. The intensive demands of ultra-endurance events create distinctive ethical responsibilities for researchers investigating pain experiences in these contexts, particularly given the IASP's (2020) emphasis on protecting participant wellbeing during pain research. Following Palmer's (2016) conceptualisation of the ethical chain, ethical considerations extend beyond initial institutional approval to encompass ongoing ethical decision-making throughout fieldwork. While procedural ethics—the formal approval processes through institutional review boards—provide essential frameworks, the unpredictable nature of ultra-endurance research requires continuous attention to ethics in practice (Palmer, 2016). This iterative ethical awareness proves particularly important when navigating tensions between capturing authentic pain experiences and ensuring participant wellbeing.

The primary ethical concern involves the potential for research participation to increase athletes' awareness of pain experiences in ways that may influence their competitive performance or safety (Harriss et al., 2019). Participants who engage in systematic reflection on pain management strategies may develop heightened consciousness of pain processing during subsequent ultra-endurance endeavours. This applies whether through longitudinal self-monitoring or concurrent think-aloud protocols during competition. While this reflexive awareness often proves beneficial for athlete development, it represents an intervention effect requiring careful management throughout data collection phases and explicit disclosure during informed consent procedures.

Field-based data collection during actual ultra-endurance events presents additional safety considerations aligned with sport and exercise research ethics guidelines (Harriss et al., 2019; Palmer, 2016). Think-aloud protocols employed during competition requires careful training to ensure verbalisation does not compromise concentration, decision-making, or wellbeing during critical performance moments. Pre-event training sessions should focus on developing natural verbalisation patterns that maintain performance focus while capturing authentic cognitive processes. Risk assessment protocols require continuous monitoring to detect signs of distress that might compromise safety. However, this must align with event protocols and safety guidelines, as support and medical assistance are usually in place. Ultra-endurance athletes, although self-supported and autonomous in most ultra-endurance events, are still subject to experiencing extreme physical distress during competition rendering them potentially vulnerable research participants (Palmer, 2016). This is despite possessing high athletic competence and decision-making capacity in other contexts. Research in such contexts will necessitate that participant safety remains paramount, even at the expense of data collection opportunities (Harriss et al., 2019).

Ethical considerations regarding participant burden and research fatigue also align with principles of beneficence and non-maleficence (Beauchamp & Childress, 2019). These principles are applicable to extended longitudinal designs that employ weekly data collection protocols and inventories designed with minimal burden that respect participants' training and competition schedules. For professional athletes, research participation occurs alongside competitive careers, intensive training demands, and other life commitments. This necessitates flexible data collection modalities that accommodate variable schedules. Iterative consent processes that extend beyond initial approval are essential for maintaining ethical rigour across extended engagement periods (Palmer, 2016). These include regular check-ins that reiterate the right to withdraw and provide opportunities to discuss research experiences.

Pain research with elite athletes also involves considerations regarding competitive confidentiality (Harriss et al., 2019). Pain experiences and coping strategies represent performance-relevant information that could affect competitive advantage if disclosed. Data collection and storage procedures must incorporate enhanced confidentiality protections, with particular attention to ensuring that individual pain management approaches remain secure within research contexts. In small, specialised athletic communities such as ultra-endurance sport, participants may be identifiable through distinctive biographical or performance characteristics even when pseudonyms are employed (Mellick & Fleming, 2010; Palmer, 2016). Hence requiring careful attention to potentially identifying details throughout data presentation.

## 2.6 Thesis Structure

Chapters 1 and 2 have established the research context, philosophical framework, and researcher positioning, establishing the foundation for the theoretical and methodological approaches for this thesis, to bridge the current gaps in knowledge identified. The research questions will be addressed in three empirical studies and will conclude with chapter 6, discussing the integrated empirical key findings:

Chapter 3: Retrospective Analysis of Pain Experiences

This study will use interpretative phenomenological analysis (IPA) to explore how female ultra-athletes make sense of their accumulated pain experiences. Through in-depth interviews with 13 athletes from diverse ultra-endurance disciplines, this study aims to examine how participants interpret and give meaning to their experiences of pain and discomfort. The choice of IPA aligns with interpretivist epistemology, enabling deep exploration of individual experiences while acknowledging the researcher's role in interpreting these accounts. This study primarily addresses the research questions by focusing

on the retrospective accounts of the female ultra-endurance athletes and their sport-specific embodied pain experiences and coping.

Chapter 4: Longitudinal Investigation of Pain Management

This study will follow three professional female ultra-triathletes through a 64-week competitive season, employing a mixed methods multiple case study design aligned with the pragmatic worldview (Cresswell & Cresswell, 2020). This study design will enable both detailed individual case examination and cross-case comparison (Yin, 2018), while its convergent parallel structure will facilitate integration of multiple data sources. The study will combine systematic quantitative assessment of pain (MPQ-SF; McGill, 1987), coping strategies (SIP; Meyers et al., 1992), recovery patterns (RESTQ-Sport-36; Kallus & Kellman, 2016), and mood states (BRUMS; Parsons-Smith et al., 2017, 2022; Terry & Parsons-Smith, 2021) with qualitative data from weekly reflective journals, periodic semi-structured interviews, and field observations. This comprehensive approach aims to address the research questions through the seasonal patterns in pain experiences and management strategies, by examining how reflection and experiential learning inform future coping strategies during competition.

Chapter 5: Real-Time Analysis of Pain Experiences During Competition

This field-based investigation will examine real-time pain experiences and coping strategies through a mixed methods multiple case study design with five female ultra-athletes during competition. This naturalistic approach aims to gather answers to all three research questions by implementing a three-phase temporal framework to capture the complete competitive experience. The pre-event phase will combine semi-structured interviews exploring preparation strategies with baseline SIP assessments (Meyers et al., 1992) to document anticipated coping approaches. During the competition, the study will employ Think-aloud protocols (Eccles & Arsal, 2017) to capture immediate cognitive processes,

complemented by adapted McGill pain questionnaires at predetermined checkpoints and systematic field observations. The post-event phase will utilise reflective interviews to examine participants' interpretations of their pain experiences.

Chapter 6: Integration and Discussion

This chapter will bring together findings from all three studies to develop a comprehensive understanding of female ultra-athletes' pain experiences across different temporal dimensions. The chapter will evaluate the theoretical and methodological contributions of the research, present practical implications for athletes and support staff, and identify directions for future research in this field.

## Chapter Three: Retrospective pain experiences in female UE athletes[1]

This chapter introduces the first study exploring the female ultra-endurance athlete's lived pain experiences through a biopsychosocial lens. Interpretative Phenomenological Analysis (IPA) was used to examine how biological, psychological, and social factors interact to shape athletes' understanding and management of pain in ultra-endurance sports. The research findings begin to formulate the answers to the research questions from a retrospective temporal dimension.

### 3.1 Introduction

**'Pushing myself beyond the limits': Exploring the lived pain experiences of female ultra-endurance athletes through a biopsychosocial lens**

I report to you from a pool of lymphatic fluid. Each of my toes is a swollen hot dog...The markers of damage are in my toenails as well...four of them are completely detached...my feet throb; they literally pulse with aching pain...My mind is scarred too but it's too soon to really process that sort of pain...This is what running a continuous 206.6 miles with 78,000 feet of elevation gain does (Hicks, 2014, p.178).

This extract of enduring and persevering through pain, discomfort, and fatigue will resonate with a variety of ultra-athletes. During training and competition, different types of expected and normalised non-injury pain (see chapter two for a detailed overview of types) have been viewed differently as the 'deposit' or investment through which performance is extracted, holding with it symbolic value (Bale, 2004) when it is a result of fatigue, or hard-worked muscles, rather than of injury (Bluhm & Ravn, 2022). This vivid account illustrates the complex reality of ultra-endurance pain experiences and how athletes must appraise and develop an embodied understanding to determine the type of 'good' or 'bad' pain being experienced as being injury-related or not (Allen-Collinson, 2016; Allen-Collinson &

---

[1] This study is now under review for a peer reviewed publication

Jackman, 2022; Hanold 2010; Lev, 2021; McNarry et al., 2020, 2021). This occurs during challenging environmental demands while managing complex interactions between psychological responses, social expectations, and cultural norms around pain endurance (Antonini-Philippe et al., 2016; Hanold, 2010; McNarry et al., 2020).

Researchers' current understanding of pain has evolved beyond simple biological models to recognise pain as a complex, multidimensional phenomenon. Pain emerges through the dynamic interaction of biological processes (such as central nervous system processing), psychological factors (including cognition, affect, and behaviour), and social-environmental contexts (encompassing cultural norms and interpersonal influences). This biopsychosocial framework provides a theoretical foundation for understanding how ultra-endurance athletes interpret and respond to pain based on the integration of physical sensations, psychological meaning-making, and social contexts (Hall et al., 2022; IASP, 2020; Lev, 2020; Melzack, 2001; Melzack & Katz, 2012; Moseley & Arntz, 2007). The International Association for the Study of Pain (IASP, 2020) reinforces this approach through three key notes accompanying their revised pain definition: pain is always a personal experience influenced by biological, psychological, and social factors; through life experiences, individuals learn the concept of pain; and a person's report of an experience as pain should be respected. This biopsychosocial interaction promotes a more holistic view, acknowledging the multitude of manifestations and meanings associated with pain as a phenomenon (Asmundson & Wright, 2012; Hall et al., 2022; Heil, 2012; Rochat et al., 2018). The relative contributions of each domain are neither predetermined nor static and their relevance and contribution may vary between each ultra-athlete (Jull, 2017).

The current research on ultra-endurance athletes has tended to be examined from single discipline perspectives. For example, biological studies investigating issues relating to pain tolerance, injuries, cramping, gastrointestinal problems, menstrual pain, and temperature

affecting performance (Holt et al., 2014; Mauger & Shirrefs, 2019; Pettersen et al., 2020; Schultz et al., 2012; Thorpe, 2014). Psychological research exploring self-efficacy beliefs and confidence in one's ability to manage pain, effects of stress, thoughts about quitting, and a willingness to participate in activities when pain is present (Anstiss et al., 2020; Corrion et al., 2018; Geva et al., 2017; Hainline et al., 2017; Holt et al., 2014; McCormick et al., 2019; Roebuck et al., 2018; Whitton et al., 2020). Social studies examining how the importance of social support and positive influence of ultra-communities' influence pain experiences and coping with pain (Atkinson, 2008; Cronan & Scott, 2008; Hanold, 2010; Holt et al., 2014; Simpson et al., 2014). While valuable, this fragmented approach fails to capture how these elements holistically interact in shaping lived ultra-endurance pain experiences.

This multidimensional nature of pain requires theoretical frameworks capable of capturing how athletes develop their tacit understanding of pain through embodied experience. Embodiment perspectives reveal how this knowledge emerges through lived bodily experience in specific sporting contexts (Merleau-Ponty, 2001). Combining the biopsychosocial lens with a phenomenological approach can offer insightful avenues into accessing female sporting experience (Allen-Collinson, 2013), especially when using a variety of different ultra-sports to illuminate the interesting commonalities or differences in their shared pain experiences to provide more analytical across different ultra-sport settings and naturalistic generalisability enabling ultra-endurance athletes across disciplines to recognise resonances with their own lived experiences (McNarry et al., 2020; Smith, 2018).

Different pain coping strategies used by runners have highlighted internal sensory monitoring for body familiarity and active self-regulatory or distraction techniques to endure existing discomfort and pain (Brick et al., 2015, 2016; Simpson et al., 2014). Pain, and pain tolerance in particular, played a significant role in many ultra-athletes' sporting experiences, particularly elite and high-level athletes who have reported higher pain tolerance compared

with normally active control participants (Hainline et al., 2017; Heil, 2012; Pettersen et al., 2020). One ethnographic study examining a male and female recreational long-distance runner's pain perception and tolerance, revealed that a form of being addicted to running inspired their capacity to endure high levels of pain (Gross, 2021). However, although low pain perception may predispose a person to become a long-distance runner, it remains unclear whether low pain perception is cause or consequence of continuous extreme training (Freund et al., 2013).

Therefore, the aim of this study was to use an IPA methodology to explore the retrospective lived pain experiences of the female ultra-endurance athlete, through a biopsychosocial lens, within the context of both training and competition. Using a holistic approach would enable a shared growth in practical knowledge and understanding of the multiple manifestations and meanings associated with pain (Hall et al., 2022; McNarry et al., 2020) and inform future interdisciplinary practice and support for these athletes within the context of the ultra-endurance environment (Jull, 2017).

Given this identified gap in current research, this study aimed to explore how female ultra-endurance athletes develop and use their sense-making of ultra-endurance pain experiences. Using IPA methodology enabled exploration of how athletes make sense of pain through integration of physical sensations, psychological interpretation, and social influences within their specific sporting contexts. This methodological choice aligned with both the biopsychosocial framework and the fundamentally embodied nature of pain experiences in ultra-endurance sports. Three interrelated research questions guided this investigation: How do female ultra-endurance athletes make sense of their lived pain experiences contextualised to their sport? Which biopsychosocial factors have shaped their perceptions of pain and use of coping strategies? How does self-reflection of their pain experiences shape future performances? Having established the theoretical foundations and research questions, the

following section details the methodological approach that enabled access to these complex, multidimensional pain experiences within ultra-endurance pain experiences.

## 3.2 Method

Following the pragmatic worldview established in Chapter 1, where methodological decisions are driven by research questions rather than paradigmatic allegiances, the research questions required an interpretive approach (Johanson et al., 2024), so the use of IPA methodology was the most appropriate experiential approach to use, to provide detailed examinations of the ultra-athletes' personal lived pain experiences (Smith et al., 2022). It produces an account of lived experience in its own terms rather than one prescribed by pre-existing theoretical preconceptions and it recognises that this is an interpretative endeavour as humans are sense-making organisms (Smith & Osborn, 2015). Being explicitly idiographic in its commitment to examining the detailed experience of each case in turn, prior to the move to more general claims, it is a particularly useful methodology for examining topics which are complex, ambiguous and emotionally laden such as pain (Smith & Osborn, 2015). The inquiry was sharpened by IPA's inductive, interpretive analysis, providing an illumination of what is presented but importantly grounding that firmly in a close examination of what the participant has said. Ultra-sports can be viewed as body centred activities exemplifying Merleau-Ponty's embodiment through a heightened kinaesthetic awareness and embodied sense of space, developed through many hours of 'burning in' movement pathways (Hall et al., 2022).

### 3.2.1 Participants

Following institutional ethical approval (SMEC_2018-19_062), (see appendix A.1, page 381), 13 female ultra-endurance athletes aged between 35 and 55 years old (M = 44.08; SD = 5.40) consented to partake in the study (see Table 3.1 for demographics). They were recruited via social media and purposive sampling ensured that participants shared the same

contextualised characteristic of competing in ultra-endurance sports (Robinson, 2014). A 'snowballing effect' from two athletes also resulted in further recruitment (Robinson, 2014). Inclusion criteria ensured all recruited participants were female, ages 18-65 years, spoke fluent English language, and their various sports qualified as ultra-endurance according to the definition by Zaryski and Smith (2005).

**Table 3.1**

Study 1 Participant Demographics

| Pseudonym | Ultra-Endurance Sport Type | Age | Competition Level | Experience (years) | Nationality |
|---|---|---|---|---|---|
| P1 Hazel | Trail Running | 46 | Amateur | 8 | French |
| P2 Kath | Triathlon | 46 | Age-group | 6 | Australian |
| P3 Kellie | Trail Running | 45 | Amateur | 6 | British |
| P4 Clare | Trail Running | 51 | Amateur | 5 | British |
| P5 Anne | Triathlon | 38 | Professional | 5.5 | British |
| P6 Kate | Triathlon | 40 | Professional | 9 | British |
| P7 Abbie | Trail Running | 45 | Amateur | 5 | British |
| P8 Debbie | Trail Running | 49 | Amateur | 5 | British |
| P9 Freya | Swimming | 43 | Amateur | 12 | British |
| P10 Tasha | Trail Running | 35 | Amateur | 9 | British |
| P11 Holly | Cycling/ Trail Running | 55 | Elite/ Ex-Olympian | 5 | American/ French |
| P12 Jean | Triathlon | 38 | Amateur | 6.5 | British |
| P13 Nina | Triathlon/ Adventure Racing | 42 | Amateur | 6 | British |

To ensure that they were able to reflect on their contextualised event pain experiences, a minimum of 5 years (M = 7.45; SD = 2.83) racing experience was considered a reasonable temporal frame, as willingness to endure must be learnt gradually over time and with

experience, to distinguish and tolerate forms of pain and discomfort (Allen-Collinson &

Jackman, 2022). The level of competition could range from recreational/amateur to elite

within their chosen sports of triathlon, trail running, cycling, open-water swimming, and

adventure racing. This resulted in a sample of 10 recreational amateurs, 1 age group

representative competing for their country, and 2 paid professionals. The main residence of

participants was Europe, Northern America, or Australasia which provided a homogenous

cross-cultural sample in line with practice guidelines for IPA studies (Smith et al., 2022).

### 3.2.2 Data collection

A semi-structured interview was chosen as the most appropriate method for

participants to discuss and reflect on their retrospective personal experiences of pain and so

providing insight into the meanings of these experiences through their language used in the

context of their sport. An interview guide (see appendix B1, page 384) was developed to

facilitate the elicitation of perceptions, stories, and reflections of the athlete's 'lived

experiences' of pain (Smith & Nizza, 2021; Smith et al., 2022). The guide was piloted using a

female ultra-athlete which was recorded and evaluated to assess the interview process. As a

result, different types of contrast, comparative, narrative, and evaluative questions were

finalised for the interview guide, with additional prompts and probe questions (Smith &

Nizza, 2021). Initial questions were asked to develop rapport and obtain a contextual picture

of each participant, e.g., "Tell me a bit about yourself and how you got into your ultra-

sport?". Follow-up questions explored the perceptions, tolerance levels, self-awareness, and

reflections of pain during training and event-related participation, e.g., "How would you

describe your tolerance levels for pain?" and "If you reflect on pain experienced during

training or a race, how does this influence the next training session or race?". In accordance

with the need for dynamic exploration of thoughts and ideas, participants were encouraged to

take ownership of the interview and make sense of their own experiences to capture the

interplay between biological experiences of pain, psychological interpretations, and social influences within their sporting and cultural contexts (Finlay et al., 2018). The researcher made notes on the guide throughout to ensure the order of questions was flexible which retained the freedom to probe further into participant-generated answers that reflected the aims of the research (Smith & Nizza, 2021). Due to the geographical dispersion of the sample, 12 interviews were conducted online, and 1 was completed face-to-face (Iacono et al., 2016). At the start, participants were briefed on the interview format, confidentiality, and use of pseudonyms for anonymity (Smith et al., 2009). In addition to the prior written consent, participants verbally consented to the interview format and being recorded by Dictaphone. Interviews lasted between 61.50–140.47 minutes and all recordings were transcribed verbatim.

**3.2.3 Data Analysis**

Following IPA's commitment to inductive analysis and phenomenological exploration, the initial analysis remained close to participants lived experiences without imposing theoretical frameworks. However, as patterns developed from the data, several theoretical frameworks offered valuable interpretive lenses for understanding these experiences. These frameworks, including the Neuromatrix Theory (Melzack, 2001), Self-Regulation Theory (Zimmerman, 2000), and the Metacognitive Framework (Brick et al., 2015), are integrated into the discussion section to help contextualise and explain the themes while preserving the phenomenological integrity of participants' accounts.

From a contextualist standpoint knowledge produced was context-specific and influenced very much by the main researcher, i.e., interpretations of participants, their pain experiences and of the observer i.e. the researcher's interpretation depends on participants. All accounts are valid because of this multiple standpoint and context specific epistemological stance, and findings are grounded in the data backed up by providing quotes.

The aim of this qualitative investigation was analytical generalisation (Smith, 2018) The aim was to illuminate and make sense of pain experiences in the context of their history, culture, and their environment during their training and race or event participation (Smith et al., 2022). The four IPA analytical phases were closely followed (Smith et al., 2022). As analysis is an iterative and fluid process of engagement with the script, a close, line-by-line analysis of the experiential claims for the athletes to gain in-depth familiarity was conducted which enabled an understanding of their experiences. Exploratory notes were made in the transcripts which led to experiential statements that were clustered to make personal experiential statements with a focus on the embodiment and perceptions of their context-specific experiences. For example, what their sport meant to them and how they interpreted the differences between pain and discomfort in context of their everyday life and sport. This process was repeated for each case and although the fore structure was changed moving from one case to the next, the process of rigour was maintained by following steps 1–5 in close detail.

Once completed, the case-level personal experiential statements were scanned with great attention for similarities, differences, and connections to formulate two group experiential themes to show the convergence in the participants' experiences. These two group experiential themes represent one possible interpretation of the data, including convergences, divergences, and relationships evident in the data at the time of analysis (Finlay, 2014; Finlay et al., 2018; Smith & Nizza, 2021; Smith et al., 2022). The analysis involved a double hermeneutic where the participants' sense-making of their pain experiences was first-order and the first author's sense-making of their sense-making was second order, through their own experientially informed lens (Smith et al., 2022). This facilitated a coherent, plausible, and sufficiently transparent account relating to these events (Smith, 2019;

Smith & Nizza, 2021; Smith et al., 2022) and enabled an idiographic stance and provided space for the author's reflexive practice (Finlay, 2002, 2014; Smith & Nizza, 2021).

**3.2.4 Methodological Rigor, Transparency, and Openness**

Three quality indicators (Nizza & Smith, 2021) were addressed to ensure methodological rigor throughout this study. Firstly, to promote methodological rigor, the first author engaged in reflexivity regarding how their personal background and previous work experience (i.e., working as a soft tissue therapist, a sports science lecturer/manager/researcher, and being an experienced competitive triathlete/cyclist) could have influenced the holistic biopsychosocial approach. Secondly, linked to the noted personal background experiences, a reflexive journal was maintained throughout to record their forebearing understandings or expectations, and how any explicit and implicit assumptions, values, and preconceptions could influence the research process. For example, the reflexive journal helped with reflections on how biomedical background experience and knowledge could influence interpretations of the meanings of the athletes' perceptions of pain or discomfort and their seriousness (Finlay, 2002, 2014; Levitt et al., 2018; Smith et al., 2022). Thirdly, the supervisors acted as critical friends for the reflexive acknowledgement on the interpretations, chosen extracts and titles in the participants' voice, analysis, and discussion points (Korstjens & Moser, 2018; Smith & McGannon, 2018). The prolonged engagement within the data ensured a greater familiarity of the ultra-athletes' experiences and setting which enabled key extracts to be selected from at least four participants to ensure themes were representative of the group (Robinson, 2014; Smith, 2011). In terms of transparency, the prevalence/frequency of all participants' experiences contributed to the group experiential themes so that all participants' experiences were synthesised in the themes, but not all were used for extracts. To provide transparent documentation of participant representation across

themes, Table 3.2 includes a column indicating which participants contributed to the evidence within each theme (Smith, 2011).

### 3.3 Results

The conceptual cross-case analysis led to the development of two group experiential themes as shown in Table 3.2 and are representative of all 13 participants. The themes are portrayed using the participant voice: a) *I really pushed myself above and beyond the call of duties*, reflecting the complex interplay between physiological pain tolerance, psychological drive, and social expectations for how they were all able to push through pain and which biopsychosocial factors influenced their perceptions and cognitive ability to cope; and b) *Experience is gold* representing the development of embodied pain knowledge through physiological adaptation, cognitive learning, and social support. These themes demonstrate how reflecting on pain experiences helped the participants to make sense and distinguish between perceptual differences for the seriousness, causes, and types of pain. These reflections also informed contextualised coping strategies for dealing with pain in their ultra-endurance events as well as everyday life.

**Table 3.2**

Study 1 Group Experiential Theme and Sub Themes

| Group Experiential Themes | Sub theme | Participants contributing to evidence within themes |
|---|---|---|
| I really pushed myself above and beyond the call of duties | The underlying drive for pushing through pain | Freya; Debbie; Clare; Tasha; Hazel; Kath; Kellie, Nina |
| | Self-preservation versus self-harm | Holly; Kate; Freya; Anne; Tasha; Kath; Abbie; Clare; Anne |
| Experience is Gold | You learn when the pain is going to be a showstopper | Kath; Holly; Abbie; Anne; Clare; Freya; |

| | | |
|---|---|---|
| I know things are tough if I'm consciously controlling my thoughts | Anne; Kath; Hazel; Freya; Jean; | |

### 3.3.1 I really pushed myself above and beyond the call of duties

This group experiential theme reflected the expectancy, commitment, and underlying drive to complete their training and refuse to dropout in a race. Experiencing pain and pushing through pain was considered part of the job, and a range of biopsychosocial and cultural factors informed how they experienced the pain. The interplay of biological adaptations (developed pain tolerance), psychological characteristics (determination and drive), and social influences (cultural expectations within ultra-endurance communities) shaped not only how athletes experienced pain physically, but also how they interpreted its meaning and responded to it within their sporting context. The following two subthemes: 'The underlying drive to push through' and 'Self-preservation or harm' illuminate specific interpretation and detail.

***The underlying drive to push through pain.***

This subtheme highlighted the individual factors that shaped or influenced each participant's underlying drive to continue pushing through their perceived pain. For some, the experiences of coping with external pressures outside of their sports, such as juggling with busy work and family commitments, and dealing with past or present trauma experiences, all transferred across into their helping them reframe any sport-related pain experiences as something they could deal with. For example, Freya's childhood emotional trauma was now her: "Source of inner strength and ability to cope with adversity, persevere, and keep going, like a survivor mentality, I'm not gonna let this beat me". Similarly, for Debbie: "My personal background shaped my tolerance levels...I was brought up in an abusive home...so I was in the care system...I had such an isolated background, let's say it made me a lot stronger as I

wasn't sugar coated" which could explain why she refused to acknowledge experiencing or feeling pain in races no matter how tough the race.

This transfer of coping capacity across contexts demonstrated how past experiences shaped both pain interpretation and management strategies. Similarly, Clare's experience as a police officer and single mother influenced her pain perspective: "I'm a police officer, I put up with a lot of shit at work; ...I'm a single mum, that's hard going but I seem to just cope with it; pain itself [in comparison], it's just a mild inconvenience". These accounts revealed how occupational and life experiences created a biopsychosocial framework for pain interpretation combined to reshape how pain was experienced and interpreted pain in ultra-endurance contexts. This demonstrated how pain perception is not merely a physical experience but developed through the integration of bodily sensations, psychological meaning-making, and socially constructed identities. Indeed, their negative life experiences had become a positive source of energy and appeared a source of escapism, serving to build their confidence to cope.

While reflecting on her perceived unhelpful characteristic of perfectionism, Hazel's self-awareness transformed into self-enlightenment and experiential learning of pain:

> I was always a type of person I wanted to do everything perfectly. When you run you must make mistakes and you have to learn from your mistakes...I cut myself a lot more slack, I'm much more relaxed...experiencing a little bit of pain or discomfort is actually necessary if you want to reach a difficult goal...how can you be happy if it's too easy? Ultra-running has taught me, to reach the point where I am at now, I think it will have taken me decades of therapy...you must be in touch with your core values and who you are, how you react to pain, how you react full stop. I'm very happy; it's a school of life. (Hazel)

This learning to endure in running, being out of her comfort zone, and not being able to always control the elements or environment, had provided Hazel with the skills and foresight to become more compassionate with herself in everyday life, facilitating a calmer psychological wellbeing and a sense that to be fully at one in her life she needed to accept it was ok to not always be in control. This learning not to be perfect resonated with other young athletes who struggled with unsustainable demands to embody superwoman ideals through time-management skills and future-oriented achievement (Ronkainen et al., 2021).

Other psychological characteristics that helped participants drive to push through pain included being determined, stubborn, independent, pragmatic, resilient, strong-willed, positive, and competitive. For Kath, her competitiveness against other female competitors was a real driver as she recalled how she would be 'banking' each tough session in her mind to remember what it would feel like when it came to race day:

> I am competitive and I think to myself when I'm in the basement doing those horrible workouts where I'm just counting through one song at a time just to get through it, I think to myself this is what the girls who are winning my races - this is what they do...if I want to be at the top of the game, if I wanna be one of the fastest girls out there then I have to do this.

Kath, like all of participants, expected and embraced pain as part of her training process to improve. However, a dichotomous situation became apparent for some between exercise dependency and overuse issues as they pushed their bodies in search of mental wellbeing benefits but at the detrimental cost of their physical wellbeing. This potential for overuse was exemplified by Clare but resonated for most participants trying to rectify and ignore any niggles at the same time: "I want to be able to manage the pain myself, and if it needs treatment, I almost feel a sense of failure, a loss of control, I wanna be doing this and don't wanna stop". Avoiding medical advice was common and the challenge was how to

integrate their own embodied response to pain with the assessment and treatment offered by the medical profession, resonating with other athletes

The underlying drive to push through pain meant that participants prioritised their training over other commitments. Although for some, their family members preferred this prioritisation to the alternative wrath if they could not train, Kath felt judged by family and friends for being selfish to prioritise herself and training over her multifaceted cultural roles of mother, wife, and employee:

> What I do in the grand scheme of things is so insignificant and so dumb ...you know it's very selfish it's all about me and those sorts of things like really creep in, cos I'm gonna wipe myself out for this workout and you know I need to get home rush around and do all these things for the kids or whatever, and I don't wanna be so tired...some days I question what I do...why am I putting myself through this for something that's so about me...I try to you know mask it and say things like my kids are gonna this is all gonna rub off on them one day or I don't know I think they're probably more harmed by it sometimes with you know, 'well mom's out of the house again training I suppose we'll just watch tv' but you know they're old enough I suppose...you should find something else to do but they don't, that's my bag. You know, I have a bit of guilt but I'm able to push that aside sometimes and yeah be selfish. (Kath)

Yet, despite this societal influence of creating Kath's mom guilt eating away at her conscience, her drive to remain focused on preparing for her races was always stronger and more influential, highlighting how inextricably linked physical and mental wellbeing were to their daily lives and training habits for an event.

### Self-preservation versus self-harm.

This sub-theme revealed the complex decision-making processes around the benefits of pain tolerance and risk assessment for the fine line between entering potentially self-

harming situations. Participants demonstrated implicit understanding of their bodies' signals while acknowledging the risks of overriding protective mechanisms. Holly articulated this balance through her metaphor of the body: "Our bodies are unique factories that protect us and when you cross that barrier and your body doesn't have the capacity to protect you anymore, that's when you have to stop" (Holly). This extract represented the tacit knowledge of their bodies and the measured risks they took while in the driver's seat for knowing when to stop, rest, or continue to push through pain. While Kate's account revealed potential dangers of high pain tolerance:

> I would have graded it a 7, for most people it'd probably be a 10...I got a scan, and I had a full break through the sacrum...I think with ironman you get used to pain because the race is so painful, it's just one of the aspects of it. You put that pain into a locker and for me I think that's quite dangerous. With the stress fracture, I knew something was up, but again I just cracked on and ignored it. (Kate)

The metaphor of using a locker for detaching herself from race pain illustrated a learned desensitisation cognitive strategy to deal with the expected severity. Ironically, the language use of 'cracking on' was metaphorically and literally true as she was ignoring the symptoms of a cracked/fractured sacrum. This example resonated for most, showing a dichotomy between actively pushing pain away, with the help of their high tolerance levels and being at risk of pushing the boundary towards self-harm, i.e. by overriding the body's messages, denying injuries, illness, or niggles, overusing/overtraining, with a minimal rest and recovery period. In Freya's extreme case, following hundreds of jellyfish stings, she finally lost consciousness eleven and a half hours into her swim and was rushed to hospital to be pumped full of steroids: "Looking back I desperately wanted to get out of the water, but I wouldn't let myself because that to me isn't on the menu. When I'm doing the swim, I swim

until I finish". Her near-death experience was a defining catalyst to reflect on this dichotomy of self-preservation versus self-harm, and the deep gratitude for her life changing experience.

These specific examples demonstrated different attitudes when weighing up the benefits versus costs of disregarding their self-preservation in pursuit of personal goals and wellbeing. Although for Anne, displaying too much self-preservation was more of an issue:

I often feel like I'm racing in a controlled conservative manner, to get to the end rather than fully pushing myself to the levels and the numbers that show in training. It's the question mark at the moment, making the next step in my performance...I refer to it as almost racing with a handbrake on sometimes. (Anne)

Although not stated, a previous running race experience she had recounted, where she had collapsed from over-exertion just before the finish line, may have influenced her decision to push beyond her limits for future racing scenarios. Anne's cultural and gender-related beliefs had also shaped her perceptions and coping with pain:

I don't know though if this is more specific to females, or to me, or to Britishness but being able to make those judgements in a race of reacting to a situation and say no actually I'm going to have to put myself in a really uncomfortable position for the next 10 minutes...knowing that you've still got 3 hours of racing on the bike...there are women that do that a lot better but I see it more of a male trait that they can go.

This suggested an internal conflict of cultural influence and a gendered socialisation of how to cope and react, and how the experience of being British was interpreted as being: "Off the back of an older generation" she had been socialised by which led to her upholding the stoic "British stiff upper lip" of those significant others saying to her: 'Show you're strong and not a sign of weakness, be independent, manage things, don't cry, and don't show your emotions'. These significant others had imprinted their beliefs and norms, and both had

subconsciously or consciously filtered into the race context and what constituted as being acceptable or was applauded.

Other factors that could enhance or adversely affect their high tolerance levels included the context of their social environment, such as belonging to an ironman and trail-running sub-culture. For example, a participant's decision-making on how much pain to tolerate or how much time to recover, could be influenced by how much they fully immersed themselves within the accepted norms and behaviours within that subculture:

There is a badge of honour for how much you battle through pain. If you wanted to, you could let yourself feel a bit inferior, as if you're not strong, if you choose to ease up on training, or choose to rest, or choose not to race, or choose not to finish a race. It's being strong enough in yourself to know what you want...it can be difficult when it's sort of applauded. (Tasha)

This extract highlighted how the ultra-endurance community could be socialised to derive status for their physical suffering but at the cost of facilitating overtraining and affecting their overall wellbeing. Using mixed temporal tenses, Tasha admitted an ongoing battle to stop her corporeal self-destructive behaviour in pursuit of psychological wellbeing:

That first injury absolutely broke me, and obviously you can't break when you've got kids and your life to get on with...I just found everything really hard and I didn't learn straight away...now I'm more prepared to listen to my body and if it means I'm slightly more cautious than I ever was, I'd rather take a rest day, than I would be to continue beasting myself and then be out for months. Before I'd very much ignore it...I'd literally just be like I'll be fine, it'll stop hurting at some point. Whereas now I'm not up for that and I'm sick, I got sick of being in pain when I get injured.

Tasha demonstrated the dichotomy between how these pursuits could ironically curtail the one thing they all needed to do, with her telling language use of 'beasting', often associated with macho ultra-endurance subcultures for tolerating pain in training and races.

The role of significant others on pain tolerance levels took on many guises with direct, indirect, or virtual presence. For example, Kate demonstrated a corporeal understanding of her body influenced by a shared experience of training with her husband: "If it's during an interval session together, we'll encourage each other to hurt and to handle more pain" and reflecting further, "I think the whole thing about training this pain barrier is developing the knowledge of pushing nearer and nearer to that limit and understanding the levels of discomfort that you really can put up with". This showed a conscious awareness and focus on the bodily sensations and the iterative process of putting meaning to her pushing the limits. Whereas Kath drew inspiration from an indirect influence from her husband's characteristics: "I see it as a sign of my mental strength that I can push through stuff. My husband is a real trooper ... ever-ready bunny...I feel like in some ways I step up to kind of meet his standards". This vicarious learning was a strong influence, and sometimes significant others did not even need to be present: "I'm motivated by people who follow me live on the internet and I think 'what would they think if I stopped' or 'what would they think if I let this pain take over' and I gave up" (Abbie). Thus, knowing and deciding when to stop in training or during an event was the biggest challenge for these participants. Anne recounted the risks of how sleep deprivation and fatigue affected their tolerance for pain and decision-making competing in the hours after midnight: "If you're not getting [enough] sleep, decision-making ability and mental strength is...weakened and then that's fatigued during a race...if you start to get that discomfort or that pain, it does affect your ability to manage it".

The environmental influences on pain perceptions and tolerance were exacerbated when some sports carried more risk and technique than others, for example, navigating

through the night in a high-altitude mountain pass: "I was really worried about navigation...whereas actually, getting more confident with those things, more of [my attention] can be used in blocking out the pain" (Jean). The environmental conditions of heat, cold, and altitude also affected the mood and control over their bodies by influencing decision-making on risks or personal safety. Kate's account demonstrated her mental and physical battles in a race due to the humid conditions of Asia, highlighting the importance of acclimatisation and from a more temperate climate:

> ...mentally you're just not used to that sensation of being too hot; I think probably your body shuts you down, your brain shuts you down earlier than other people who are used to it, because your brain is telling you OK this is really dangerous probably earlier, because you don't understand how much you can push in that environment.

Finally, the unique biological effect of the different stages of hormonal cycles could affect the wellbeing of some athletes. For example, the effects of having menopausal hot flushes caused one participant to delay putting on adequate clothing during the night and subsequently suffered with serious hypothermia. Whereas for two others, the menstrual cycle had frustrating adverse effects if it collided with a hard training session and important race:

> At the Ironman World Championships, I got my period the day before the race and day 1 is fine, not too bad, day 2 is usually the day when I get cramp and I was, uncomfortable in the morning before the race and [it] added to my anxiety. (Kath)

For Clare, her resonating complaints were very context-dependent and changeable: "Some months it [period pain] can really get me down and wipe me out; other months I can just push through, it can depend on what's going on in my life at the time" (Clare). These accounts illustrated the unique impact of sex and gender on an added layer of endured lived pain experience. In summary, this group experiential theme highlighted the different biopsychosocial factors that influenced the drive to push their pain tolerance levels,

highlighting the inextricable link between physical and psychological wellbeing and the negative effects of overtraining.

**3.3.2 Experience is gold**

The second group experiential theme represented how the embodied experiential learning and self-reflection on their pain experiences had developed into a tacit kinaesthetic awareness and knowledge of their bodies. Two subthemes represent the individualised perceptual differences of pain and their context-dependent coping strategies: You learn when the pain is going to be a showstopper; and I know things are tough if I'm consciously controlling my thoughts.

**You learn when the pain is going to be a showstopper.**

This subtheme represents participant's iterative learning and making sense of perceptual differentiations and evaluations of the seriousness and risk of pain or discomfort experienced, which were key to influencing their tolerance levels. Due to an array of experiences, pain was not an issue, nor created anxiety if they could identify the cause and maintained a process of self-monitoring and re-evaluating for risks to their bodies, such as checking for symmetry of pain on both sides. This pragmatic approach was evident for all: "I always say that if you know what the cause of the pain is, and you understand the source of the pain you can deal with it" (Kath); and helped subsequent decision-making on weighing up risk-benefits to determine whether the pain could curtail training or race day. Participants' descriptions painted a lucid picture of how they distinguished their pain types and affective responses: "Pain really talks to your mind, whereas discomfort is like an itch or niggle", this understanding was not purely physical but developed through an integration of sensation and meaning, further demonstrated by Holly using her culturally informed interpretation to explain the differences and specific risk implications:

Discomfort you could still run through, the French often call it a deaf pain, cos it's there but it's not really loud. I mean, pain for me, I just can't run anymore. I know it's across the boundary of breaking something or ripping something out, it's a whole physical trauma that takes over your body and your mind telling you to stop.

This extract illustrated their bodily know-how and tacit awareness for the severity and risk consequences, highlighting the fine line between self-preservation or self-harm. Others produced a more objective number rating, commonly used by medical practitioners to ascertain pain intensity and severity of sensory information: "If it's pain of about 7 or 8 out of 10, but I knew that I'd be ok a couple of weeks after the race, then I think I'd be able to ignore it" (Abbie). This illustrated the iterative learning of tolerance levels and a bargaining process weighing up the severity against how much recovery would be required afterwards at the cost of pushing through. However, making decisions relating to showstopper pain was usually when previous experience was drawn upon to know when to draw the line:

I can sense when something is painful and is hurting and is not normal, versus when it's painful and it's hurting and it's just the race process, the training process; the uncomfortableness of pushing yourself as hard as you can, during training or racing. Compared to a twinge, a pain that is going to lead to an injury. (Anne)

This demonstrated the expectation and acceptance of pain as being part of the sporting process but also assessing between permanent damage or training adaptations. All would continue or even start a race with a niggle or injury: "I cracked the rib whilst training...but I did the race, so that was extra pain to push through" (Clare). For some, their emotional pain based on depression or past trauma experiences were evaluated as being far worse to tolerate than any physical pain during an event: "To me physical pain is nowhere near as difficult to endure as emotional pain is. To me it doesn't even register on the same scale" (Freya). This highlighted the perceptual differences of pain and contextualised cathartic responses to how

119

they maintained their psychological wellbeing. It suggested that pain in Freya's sport was different to pain encountered in everyday life.

***I know things are tough if I'm consciously controlling my thoughts.***

This subtheme represents participant's reflective process on an array of past experiences of using a variety of individualised pain coping strategies. Cognitive strategies were contextualised to the iterative learning process of conducting dynamic risk assessments and evaluations afterwards: "Every race, every training session, is an opportunity to gain more experience and learning, you can get better at using different mindset tools" (Anne). Hazel echoed this learning: "There is no magic wand, but it's good to find little tricks" which led to their tacit knowledge of measured pain tolerance levels and effective cognitive coping strategies:

> In [ironman] training I've been really careful to test myself and know enough about what I'm capable of, to know how hard to go in a race...measure or dose your effort...focussing on things like your form, stay tidy, stay in good shape, look like you mean to go this slow...the last 5–10ks are hard...but by that stage you're close enough that you can see the light at the end of the tunnel, you can start to imagine what it's like to cross the finish line. (Kath)

All participants used cognitive strategies such as positive self-talk, reframing pain sensations, and maintaining focus on achievable goals, as demonstrated by Freya's reflections on her consciously maintaining a positive mindset and reframing her pain during a swim: "Whatever degree of discomfort I'm in at that point in time and however hellish it is, I just say to myself, this time tomorrow it'll all be over". Freya further added how learning from her pain experiences had helped her stay positive: "I learnt through swimming through so much pain that everything passes...I know from experience, it's like a fluid flowing thing...it's not something I'm fighting...it's just a sensation". This highlighted the temporal and dynamic

nature of discomfort or pain, and how to learn to accept the ebb and flow of them, rather than distancing herself. Participants demonstrated various metacognitive strategies for managing pain, integrating physical awareness with psychological control. A 'no one size fits all' approach was aptly summarised by Anne which represented everyone in having learnt to use a variety of cognitive strategies such as positive self-talk, listening to music, imagery, distraction, and disruption techniques:

> It's all the sort of stereotypical things, breaking it down or accepting that the discomfort and the pain is gonna be there...trying to switch the focus away from that discomfort. I started using disruption techniques [when] you feel yourself going into a hole of darkness and discomfort...stupid things like pulling funny faces or letting out a few random noises...throwing your arms round in the air which makes you look like a bit of a crazy woman to anyone else who's watching...it's very hard to think about discomfort and pain when you're smiling. (Anne)

Anne's account, like those of other participants, demonstrated how they had developed personalised approaches to pain management through experience. These strategies, ranging from cognitive techniques such as active distraction, physical disruption methods, and active self-regulatory techniques became part of their embodied knowledge. In summary, self-reflection and learning from pain experiences was gold in terms of embodied coping and instinctive corporeal kinaesthetic awareness to improve their capacity to manage pain across training, competition, and everyday life contexts future performances, training, and everyday life.

### 3.4 Discussion

This study explored female ultra-endurance athletes lived pain experiences through a biopsychosocial lens, guided by three research questions examining how athletes made sense of pain experiences, which factors shaped their perceptions and coping strategies, and how

self-reflection influences future performance. The findings are discussed through a biopsychosocial lens supported by the integration of aligning theoretical frameworks (see chapter two for details) that together illuminate how the participants made sense of their retrospective lived pain experiences. The Neuromatrix Theory (Melzack, 2001) provides insight into the biological pain processing, while Self-Regulation Theory (Zimmerman, 2000) and the Metacognitive Framework of attentional focus and cognitive control (Brick et al., 2015) help explain the psychological and social adaptations and responses to pain. These frameworks, when integrated, revealed how biopsychosocial factors dynamically interact in shaping the participants' ultra-endurance pain experiences.

The first Group Experiential Theme 'I really pushed myself above and beyond the call of duty' highlighted how it was considered part of the job to push through pain in training and competition assisted by their high pain tolerance levels and underlying drive. Reflecting on their pain experience influences, they revealed a range of biopsychosocial and cultural factors that shaped their perceptual differences. An inextricable link was exposed between maintaining their daily training habits and psychological wellbeing but at the risk of self-harm if warning signs were ignored. The second group experiential theme, "Experience is Gold', provided an insight into how reflecting on years of training and competition experience had provided participants with a tacit knowledge of distinguishing the seriousness between different types of pain and subsequent context-dependent cognitive strategies to cope.

The Group Experiential Theme 'Experience is gold' revealed how years of sport-specific pain experiences had developed athletes' embodied understanding of their physical sensations. Through this accumulated experience, participants had formed tacit knowledge about their bodies and pain perception that integrated biological sensations with psychological interpretation within their specific sporting and sociocultural contexts. This

developed an embodied cognition, enduring consciousness, and familiarity with their bodies during sense-making of pains, disruptors, or stressors to build up a confidence to what their body was able to tolerate under various challenging conditions (Allen-Collinson & Jackman, 222; Antonini-Philippe et al., 2016; Hall et al., 2022; Hanold, 2010; Hockey & Allen-Collinson, 2016; Lev, 2019, 2020, 2021; McNarry et al., 2020, 2021; Rochat et al., 2018; Roebuck et al., 2020; Throsby, 2013). This accumulated practical knowledge from a variety of different ultra-sport participants highlighted the convergence and divergence in their embodied cognition and perceptions of pain or discomfort and the determinants for them stopping. Perceptions are constituted by an affective experience (Merleau-Ponty, 2001), and a large part of training and racing rested on their perception and handling of pain (Bluhm & Ravn, 2023). Like other studies, the long durations of self-monitoring their pain during events and training had desensitised them to certain sensations and types of pain, making them willing to compete while injured and in pain (Deroche et al., 2011; McNarry et al., 2020, 2021; Lev, 2019; Pettersen et al., 2020).

Self-monitoring skills are vital to develop awareness of the state of physical capacities, reflected in muscle pain, fatigue, stiffness, as well as cognitive and emotional capacities, such as vigilance and positive affect (Balk & Englert, 2020). These skills represent the core of Zimmerman's (2001) cyclical self-regulation model, where athletes move through forethought (planning pain coping strategies), performance (implementing these strategies during events), and self-reflection phases (evaluating the effectives of strategies after). The participants demonstrated this cyclical process when describing how they reflected on previous pain experiences to develop more effective strategies for future events. This aligns with Zimmerman's assertion that effective self-regulation involves 'self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal

goals' (Zimmerman, 2001, p.14), especially when participants described adapting their approach to pain coping based on previous failures and success.

These skills are also a key component of Brick et al.'s (2015) Metacognitive Framework incorporating attentional focus during running performance. All the participants used internal sensory monitoring of their physiological pain sensations during training and competition to develop their metacognitive feelings of knowing the difference between injury and non-injury type pains. This biopsychosocial integration facilitated feelings of confidence they could push through discomfort, alongside developing metacognitive awareness of their tolerance levels through using cognitive active distraction and self-regulatory strategies (Brick et al., 2015). The participants' processes of self-reflecting, reviewing, and evaluating their experiences further developed their metacognitive understanding of pain sensations, creating a tacit biopsychosocial knowledge structure that informed future performance (Bluhm & Ravn, 2023; Brick et al, 2015; Zimmerman, 2001).

To understand this multidimensional integration of biological sensations with psychological interpretation in a social context, the Neuromatrix Theory (Melzack, 2001) provides a valuable framework. The theory proposes that pain is a multidimensional experience produced by characteristic "neurosignature" patterns of nerve impulses generated by a widely distributed neural network called the "body-self neuromatrix" in the brain (Melzack, 2001). The participants accumulated years of training and competition experiences formed complex pain memory patterns that influenced how new pain experiences were processed and interpreted. The biopsychosocial integration is evident in how these experiences incorporated sensory inputs (biological), interpretation and meaning (psychological), and contextual understanding developed within specific sporting cultures (social).

This biopsychosocial integration helps explain participants' ability to distinguish between different types of pain. The neuromatrix integrates multiple inputs (sensory, cognitive, and affective) to produce pain perception, which explains how participants could draw upon varied metacognitive experiences to make sense of their bodies, being hyper-aware of bodily sensations to determine how serious the pains were through an embodied cognition and whether it was perceived as a showstopper type pain, or just manageable discomfort (Brick et al., 2015; Hall et al., 2022; Melzack, 2001).

The biopsychosocial factors shaping pain experiences were further illuminated in the Group Experiential Theme 'I really pushed myself beyond the call of duty'. This revealed how participants had developed various cognitive strategies that integrated biological awareness with psychological techniques, all influenced by social expectations within their sporting communities. For example, like other studies, participants reported breaking the event down into smaller blocks or stages (Holt et al., 2014). They employed various metacognitive strategies (Brick et al., 2016) such as active self-regulatory strategies (self-talk, imagery) and active distraction techniques. Equally, problem-focused (changing the reality, pain suppression, and skills development) and emotion-focused strategies (reframing pain) (Lazarus, 1999) all proved effective when their mind struggled to block out the pain. This integration of strategies across biological, psychological, and social domains demonstrates how these athletes had developed an implicit biopsychosocial approach to pain management.

The Group Experiential Theme 'I really pushed myself beyond the call of duty' highlighted across all the participants in a variety of different sports, similar psychological characteristics and drive to explore physical and mental limits, as reported in studies of ultra-runners (Roebuck et al., 2018). The biopsychosocial interplay was evident in how their psychological drive to continue was both supported by biological adaptations to pain and reinforced by social expectations within their sporting communities. Unfortunately for some

participants, this drive to reframe pain to discomfort due to their perceived high pain tolerance levels, led to dangerous self-harming situations in events where they pushed beyond safe corporeal limits. For most participants, the drive was also behind maintaining a sense of mental wellbeing but translated into risking their physical wellbeing. Wellbeing is a complex construct that concerns optimal experience and functioning (Diener et al., 2017). This is confirmed by self-regulation being an important aspect underlying athletes' wellbeing and endurance performance (McCormick et al., 2019) and if athletes are unable to balance the demands of their sport with adequate rest and recovery between training and competition, negative consequences such as injury may arise (Balk & Englert, 2020).

Daily, most were weighing up the risk-reward benefits of pushing through pain in training, compelled to ignore their body's need to fully rest and recover, and rationalising their reasons for choosing between self-harm or self-preservation. This resonated with similar findings of a corporeal embodiment of being resistant to pain, ascribing context-dependent meaning to their experiences (Bluhm & Ravn, 2021; Heil 2012), focused on pushing 'beyond limits' (Jaeschke et al., 2016) reproducing a type of heroine within an endurance community (Hall et al., 2022) or gaining pleasure from the pain (Lev, 2019). This social dimension of pain experience highlights how cultural norms within ultra-endurance communities can influence individual pain interpretation and management. It is therefore critical for these athletes to be mindful of the long-term negative effects and deleterious consequences to their body's tissues and other important systems, impairing healing, and restoration if cortisol remains present in the body (Hainline et al., 2018; Melzack & Katz, 2012).

This biopsychosocial insight highlighted that ultra-athletes may need to be educated on these negative biological effects to their physical wellbeing stressing the importance of why they should be taking enough rest and recovery to fully aid any healing processes. This should be from relevantly qualified and experienced practitioners working with these athletes

(e.g., coaches, psychologists, and medical-related staff). If, however, they prefer to not seek practitioner or medic advice for a distrust of their gaze and pragmatic decisions (Hall et al., 2022), this advice could be delivered through a reliable and knowledgeable ultra-sport community forums. The social support dimension can positively influence biological processes, as social interaction has been found to stimulate the production of oxytocin, which is related to a reduction in cortisol levels (Uvnas-Moberg & Petersson, 2005) and may reduce long-term tissue damage and chronic pain (Melzack & Katz, 2012). This highlights how the social dimension of the biopsychosocial model can influence biological recovery processes.

Most athletes in this study needed to develop the self-regulatory skill of self-control to initiate recovery activities in between training and competition (Balk & Englert, 2020; Baumeister et al., 2007). It is important to examine the potential for exercise dependency and underlying drive to push through pain for their psychological wellbeing as it was reliant on the physical wellbeing being able to satisfy this psychological wellbeing. According to Hoffman and Krouse (2018) the high percentage of ultramarathoners would not stop training even if they learned it was not good for their physical health as it appears to serve their personal achievement and psychological motivations and their challenge orientation such that they perceive enhanced positive effects that are worth retaining at the risk of their health. Where the self-regulatory skills of monitoring and self-control were absent for some, the tenets of the Dualistic Model of Passion (DMP; Vallerand, 2012) seemed to resonate with their recounted past lived experiences of emerging exercise dependency.

The DMP model asserts that passion is characterised by an investment of time and energy in an activity that one likes, values, and assimilates into one's identity, and which has the potential to lead to positive outcomes. Through the experience of positive emotions during regular and repeated activity engagement, it is posited that harmonious passion contributes to sustained psychological wellbeing while preventing the experience of negative

affect, psychological conflict, and ill-being such as in obsessive passion. A strong obsession with their activity may thus render athletes' incapable of regulating their efforts wisely and might intentionally disregard the limits of their physical and mental capacities (Curran et al., 2015). The findings concurred with this as the participants in this study relied heavily on training for maintaining mental health, sometimes at the expense of physical recovery. This revealed a negative cyclical effect, affecting psychological wellbeing if their physical wellbeing was not healthy enough to meet the demands of the event. Thus, decision-making regarding exercise behaviour led to chronic, overuse injuries and overtraining syndrome, where they were balancing between the two types of passion, with a resonance for negative affect if daily training was infringed upon as seen in other studies (Curran et al., 2015; Gross, 2021; Guerin et al., 2013; Vallerand, 2012). Therefore, it is recommended that ultra-athletes be self-reflective to develop a more informed self-awareness about their pain perceptions, tolerance levels, and underlying drive to exercise beyond reasonable physical warning symptoms. Additionally, they should consider which significant others could play a positive role in helping to monitor their mood and functioning to help in supporting them to maintain a healthy balanced physical and psychological wellbeing (Carter & Houle, 2019).

The analysis of the findings revealed how some athletes' pain experiences were shaped by sociocultural forces operating beyond individual psychology. The sport ethic's four core norms (Coakley, 2015; Hughes & Coakley, 1991) were congruent to the analysis interpretations in theme 1. Specifically, ultra-endurance sub-culture created systematic conformity pressures that athletes learned through peer observation and modeling, positive reinforcement from coaches and other athletes, and fear of loss of competition time or being labelled as weak (McGee et al., 2024). Tasha's description of pain tolerance as a 'badge of honour' explicitly identified how communities confer status through suffering. This created conditions for what Coakley (2015) terms "positive deviance" i.e., overconformity to cultural

norms that becomes dangerous despite being valued within sport. Tasha's acknowledgment that choosing rest could make athletes 'feel inferior' revealed how the sport ethic operated as social control mechanism, wherein pain tolerance becomes psychologically necessary for legitimate athletic identity. The conformity pressures revealed reveal a deeper pattern that endurance requires continuous active labour rather than constituting permanent achievement (McNarry et al., 2021). Athletes constantly renegotiated pain tolerance, sporting identity, and bodily limits through ongoing embodied monitoring and strategic decision-making about when to push versus rest (McNarry et al., 2021). Language like 'beasting' (Tasha), 'banking' workouts (Kath), and pain 'not on the menu' (Freya) illustrated deeply internalised cultural values normalising extreme suffering as definitional requirement for ultra-endurance participation. This language reflected athletes ultimately reframing unpleasant sensations as positive through cognitive restructuring (Lev's (2019). These patterns align with researchers documenting how sport ethic conformity leads athletes to accept both physical and psychological suffering as necessary sacrifice for sporting success (McGee et al., 2024).

These sport ethic pressures operate alongside performance narratives that further intensify pain tolerance demands. Participants' accounts further revealed how pain tolerance functioned within performance narratives wherein self-worth becomes contingent upon athletic achievement (Douglas & Carless, 2009). Kate's compartmentalisation of pain into a "locker" to enable performance despite a sacrum fracture exemplified this dynamic. Kate's learned desensitisation strategy allowed her to dismiss what she rated as 7/10 pain (acknowledging "for most people it'd probably be a 10") whilst "cracking on" through literal and metaphorical fracture. This compartmentalisation reflected the learned distinction between discomfort valued as training signal and pain signals that should halt activity (McNarry et al., 2020), with Kate's high pain tolerance enabling her to reclassify showstopping injury pain as manageable race discomfort. Clare's framing of treatment-

seeking as 'failure' reflected not only performance narrative pressures but also athletes' complex relationships with medical authority where seeking care threatened both athletic identity and embodied autonomy (Douglas & Carless, 2009; Lev, 2021). Freya's refusal to exit her swim despite near-death conditions demonstrated how performance narratives shape pain interpretation, reframing suffering as commitment evidence rather than warning signal. When athletic identity dominates all other self-aspects such as 'living the part of athlete' pain tolerance becomes central to maintaining sense of self. For the athletes in this study this created psychological dependence on training that overrode protective biological mechanisms, making athletes vulnerable to narrative wreckage, (i.e., the psychological devastation when performance narratives fail through injury or inability to maintain extreme standards), when injury threatened their identity foundations (Douglas & Carless, 2009).

These cultural pressures intersected with gendered expectations, creating double conformity demands. Anne's attribution of pain-pushing capacity to "male traits" revealed internalised gender ideology wherein extreme pain tolerance is culturally coded as masculine (Krane et al., 2004; Wellard, 2016). This reflects tensions within ultra-endurance cultures where women simultaneously experience gender ambiguity, feeling both 'feminine' and 'masculine' during performance, while navigating cultural coding of extreme pain tolerance as masculine trait rather than human athletic capacity (Hanold, 2010). Kath's extensive 'mum guilt' describing athletic pursuits as 'selfish' and 'insignificant' exemplified what McGee et al. (2025) identify as the desire to please. This operates as paramount driver of female athletes' sport ethic conformity. It reveals how women's gendered cultural conditioning toward people-pleasing creates specific vulnerability within sporting cultures that valorise extreme pain tolerance. Kath's guilt also reflected tensions between maternal and athletic identities. It reflected the pressed time perspectives inherent in managing competing demands,

highlighting tensions that are distinctly gendered (Bean & Wimbs, 2021; Johansen et al., 2023; Ronkainen et al., 2021).

The lived experiences for some of the athletes in this study proved athletic toughness through extreme pain tolerance while simultaneously managing distinctly female biological challenges including menstrual cycle effects and menopausal symptoms (Allen-Collinson & Jackman, 2022). Some navigated gendered social expectations about appropriate maternal behaviour and caring responsibilities which created temporal constraints on training and recovery (Throsby, 2013). This intersection may partially explain why most participants developed dangerous overconformity patterns despite varying personalities. This revealed how ideological-level cultural forces operated across individual differences (Karos et al., 2024). Pain tolerance was not a fixed individual trait, but rather a socially constructed practice shaped by cultural narratives, with the athletes navigating additional gendered layers. Effective interventions must therefore address not only individual coping skills but also cultural systems rewarding dangerous conformity, particularly how gendered expectations intensify these pressures for female ultra-athletes (Bursik et al., 2025).

A more integrated approach is advocated that considers the full complexity of ultra-endurance athletes' experiences such as individual pain tolerance levels, perceptions of pain, and understanding their background and influential biopsychosocial factors that drive them to push through pain. By addressing biological, psychological, and social factors together, practitioners can better help athletes maintain both performance and wellbeing in these demanding sports. Three important take home messages are advised; firstly, the findings regarding exercise dependency and psychological wellbeing deserve particular attention through the biopsychosocial framework. Athletes' drive to maintain psychological wellbeing through training often created tension with physical wellbeing needs, demonstrating how psychological and biological factors can come into conflict.

This was further complicated by social influences from the ultra-endurance community that often celebrated pushing through pain. Understanding these complex interactions is crucial for developing effective support strategies for ultra-endurance athletes. Athletes should be educated on the long-term consequences of overtraining, exercise dependency, and pushing beyond the safe physical limits that their bodies can endure. Practitioners should help athletes develop alternative strategies for maintaining psychological wellbeing during necessary recovery periods. This might involve working with training groups and teams to develop more balanced approaches to performance and recovery. This could include teaching mindfulness techniques, developing cross-training options that allow for physical activity while supporting recovery, and working with athletes to build more diverse sources of psychological satisfaction beyond their sport. Secondly, athletes will benefit from an athlete-centred, inter-disciplinary approach utilising the skills and experience of qualified ultra-endurance coaches, sports psychologists, and medical providers who understand mental health disorders, and psychological aspects of injury, to gain a more holistic knowledge and understanding of the athlete and any biopsychosocial influencing factors on tolerance levels and underlying drive to push through pain (Carter & Houle, 2019).

Thirdly, provide an individualised support network that fosters an environment that is mindful of healthy, balanced physical and psychological wellbeing. Practitioners should recognise that female ultra-endurance athletes may face unique challenges related to societal expectations and physiological factors such as hormonal fluctuations. This is supported by Knechtle and Nikolaidis (2018), whose research highlighted how female athletes often have different recovery requirements than males due to hormonal variations and body composition differences, necessitating gender-specific approaches to training and recovery.

Support strategies should be tailored to address these specific challenges. Hoffman et al. (2018) found that female ultra-runners who incorporated scheduled rest periods and

monitored their menstrual cycles showed better long-term performance outcomes and fewer injuries compared to those maintaining consistent high-volume training. This evidence supports the recommendation that practitioners can help by creating supportive environments that normalise appropriate rest and recovery while still acknowledging the legitimate challenges of the sport.

Practitioners should help athletes develop comprehensive self-monitoring strategies that go beyond physical symptoms. Miles et al. (2019) demonstrated that psychological factors significantly impact recovery processes, with athletes experiencing high stress showing measurably delayed physical recovery. This research reinforces the observation that decision-making around pain and training is influenced by multiple factors, including mood, social pressure, and life stress. Teaching athletes to monitor and record these various influences can help them make better decisions about training and recovery. This might include using training logs that track psychological state and social factors alongside physical symptoms, as recommended by Joslin et al. (2021), who emphasised the importance of comprehensive monitoring protocols to prevent overuse injuries that are particularly prevalent among female ultra-endurance athletes.

By addressing biological, psychological, and social factors together, practitioners can better help athletes maintain both performance and wellbeing in these demanding sports. This integrated approach is supported by Behnke et al. (2021), who found that individualised recovery approaches yielded better outcomes for female ultra-endurance athletes than generalised protocols, highlighting the importance of personalised support systems that account for the unique constellation of factors affecting each athlete.

In terms of analytic and theoretical generalisability (Smith, 2018) the findings support the value of interpreting them through a biopsychosocial lens that integrates the Dualistic Model of Passion (Vallerand, 2012), Self-regulation theory and Metacognitive framework

(Balk & Englert, 2020; Brick et al., 2015; McCormick et al., 2019; Zimmerman, 2001), and the Neuromatrix Theory (Melzack, 2001). This integrated theoretical approach provides a comprehensive framework for understanding the complex interplay between biological sensations, psychological interpretation, and social influences that shape pain experiences in female ultra-endurance athletes. These findings offer naturalistic generalisability resonating with a variety of ultra-athletes from different sports as opposed to just one sport. For example, being self-reflective on the specific risks of their sport and cognitive strategies used to cope with pain or discomfort. Additionally, the self-awareness of balancing their self-preservation, underlying drives, and how to maintain a healthier balanced psychological and physical wellbeing in their sporting and everyday life (Smith, 2018). Future researchers should adopt a biopsychosocial lens to gain further holistic understanding of the athletes they support, to prevent practitioners acting in silos, as interdisciplinary teams provide more knowledge and experience than disciplines operating in isolation (Glazier, 2017; Jessup, 2007; Thorpe & Clark, 2020). As dealing with pain was 'part of the job', studying professional ultra-athletes would extend knowledge on perceptual differences or similarities in pain experiences and individual cognitive strategies to cope, in the context of being paid to compete.

A limitation of this study highlighted a research opportunity, to consider a naturalistic setting to further examine the multidimensional and temporal nature of other female ultra-athletes embodied cognitions of pain and contextualised choice of cognitive strategies when evaluating their sport-related pain experiences. The specific temporal comparison of longitudinal and real-time pain experiences would extend current knowledge and understanding of the self-reflective processes using tenets of underpinning theoretical frameworks for recovery self-regulation and emotional regulation (Balk & Englert, 2020; McCormick et al., 2019) alongside the tenets of self-regulation and Metacognitive

Frameworks for cognitive strategy use (Brick et al., 2015). A mixed methods case study approach that monitors mood, rest and recovery, and pain over a training and competitive period, would prove beneficial. Lastly, the inclusion of using more biological markers, such as for cortisol, in research would be a useful addition to psychosocial monitoring, to gain more objective physiological data on the physical wellbeing of the ultra-athlete to support the psychological wellbeing. Therefore, an interdisciplinary research team is advised.

In conclusion, the findings have provided a rich, holistic practical insight into how a variety of different female ultra-endurance athletes interpreted their sport-specific lived pain experiences during their training and competition, in relation to everyday life. The biopsychosocial factors that have influenced how they interpret and reflect on their pain experiences inform how an interdisciplinary support network can support their wellbeing and continued participation. Athletes should learn the benefits of recovery self-regulation in between training and races, as well as self-regulation during their sport. Fostering the right environment is crucial for a healthy, all-rounded psychological and physical wellbeing for the ultra-endurance athlete.

**Chapter Four: Longitudinal Pain experiences in female UE athletes**

The previous chapter employed IPA to explore female ultra-endurance athletes' retrospective lived pain experiences across various ultra-sports. Chapter 3 revealed how accumulated experience enabled athletes to develop embodied cognitions for distinguishing between pain types and employing context-dependent coping strategies, while highlighting how biopsychosocial factors dynamically shaped their pain perceptions. Building upon these insights, the current chapter examines pain throughout a competitive season. Specifically, adopting a longitudinal, mixed-methods case study design with professional Ironman triathletes enables prospective monitoring of how pain experiences, self-regulation strategies, and biopsychosocial factors fluctuate and interact across actual training cycles and competition periods. This naturalistic, temporal approach provides richer insight into the dynamic, lived experience of managing pain in elite ultra-endurance sport, capturing the unique pressures facing professional athletes who are paid to compete.

**Examining Three Female Professional Ironman Triathletes' Pain Experiences, Coping, Mood, Rest, and Recovery: A Longitudinal Mixed Method Multiple Case Study**

**4.1 Introduction**

Ultra-endurance athletes expect to endure discomfort, fatigue, and pain associated with arduous training and tough competition conditions (Tuffey, 2000). They become experts at enduring and even embracing physiological and psychological demands, gaining recognition for pushing through pain and ignoring injuries (Atkinson, 2008; Hochstetler & Hopsicker, 2016; Tibbert & Anderson, 2015). However, this can also increase the risk of further injury, illness, or excessive fatigue by ignoring the signs and symptoms of pain sensations (Biggins et al., 2021; Johnston et al., 2018; Johnston et al., 2020; MacDonald et al., 2023).

Triathlon is a multi-discipline endurance sport which places unique sustained mental and physical demands of high intensity and perceived efforts to finish the sequential completion of swimming, cycling, and running (Sleivert & Rowland, 2000). The Ironman triathlon (3.8-km swim, 180-km cycle, and 42-km run) is often considered one of the world's most challenging endurance events and is staged on a variety of terrains and environments around the world (Lepers, 2008). Performing at such sustained high intensities requires self-regulating recovery and pain between pushing the training and adaptation boundaries for performance, and avoiding negative outcomes, such as underperformance, injury pain, illness, poor wellbeing, and overtraining syndrome (Grim, 2020; Halson, 2014; Kallus & Kellman, 2016; Kellman, 2010; Marr, 2011; Meussen et al., 2013).

Most high-performing ultra-endurance athletes will experience one or more significant health issues that slow their progress in training at some point during a competitive season (Etxebarria et al., 2019). Problems can take many forms from an acute injury, a more chronic condition that reaches breakpoint, or a temporary illness caused by sub-optimal nutritional intake, a long-haul travel-related episode, or the usual common cold (Etxebarria et al., 2019). Because of the fluctuations throughout a season that can affect pain experiences, it is important to monitor all year-round their athletic preparation to optimise performance and prevent negative outcomes such as injury and overtraining (Dijkstra et al., 2014; Hainline et al., 2017; Kallus & Kellman, 2016; Kellman, 2010; Kellman et al., 2018; Saw et al., 2015).

A large body of research has shown that self-regulation is an important aspect underlying athletes' pain management, wellbeing, and performance (Balk & Englert, 2020). Self-regulation is an important aspect to enabling an individual to monitor and adjust their goal-directed activities. If athletes are unable to manage the competitive or environmental demands and stressors of their sport, then this may negatively affect their wellbeing (Balk &

Englert, 2020; McCormick et al., 2018b, 2019). Recovery self-regulation can help to understand the fluctuations in pain experiences an ultra-endurance athlete may encounter throughout a season. Recovery self-regulation is a relevant theoretical framework to underpin this study as it is defined as the act of identifying one's current state, one's desired future state, and undertaking actions to minimise the discrepancy between both states during the recovery phase (e.g., between training sessions or competitions) (Balk & Englert, 2020). A process model of recovery regulation proposed three specific self-regulatory skills for monitoring an athlete's performance and wellbeing: self-monitoring (e.g., pain awareness), regulation of cognition and emotion as complete recovery is only accomplished when both physical and mental resources are replenished, and self-control (e.g. initiation of taking recovery time) (Balk & Englert, 2020).

Monitoring athletes can capture how these skills of self-regulation of pain develop over a season and can be a simple and cost-effective approach when combining self-report measures such as inventories (e.g., for pain, mood, rest, and recovery) and logbooks or diaries (Balk & Englert, 2020; Saw et al., 2015). For example, there are specific inventories that would be appropriate for the monitoring of a triathlete's mood profile and psychological wellbeing (BRUMS: Parsons-Smith & Terry, 2022), rest and recovery, and sleep quality for risk of overtraining syndrome and burnout (RESTQ-Sport: Kallus & Kellman, 2016). These inventories have been effectively utilised with other inventories for monitoring triathletes (Barnett et al., 2012; DALDA: Coutts et al., 2007; POMS: McDonald et al., 2023; ABQ: Main & Landers, 2018). The use of diaries has also proven effective as a longitudinal tool for monitoring risk factors of injury or illness during high intensity periods of training (Vleck et al., 2014) and a self-reflection tool and for monitoring athletes' psychological states and wellbeing (Barnett et al., 2012; Johnston et al., 2018; Lasnier & Durand-Bush, 2023; Main & Landers, 2012).

Due to the biopsychosocial factors that dynamically interact over a season, this monitoring approach serves to obtain greater holistic insights into understanding how they influence the subjective pain experiences of a professional triathlete. This insight is important to ascertain the temporal nature for how pain is evaluated for seriousness between injury and non-injury pain (e.g. type, location, and intensity) during training and competition. Non-injury-related pain such as delayed onset of muscle soreness (DOMS), exercise induced pain (EIP), and exercise-associated muscle cramp (EAMC) are expected and accepted by athlete, coach, and physiotherapist as by-products of training and performance and often perceived as good, positive pain (Bolling et al., 2019; Hanold, 2010; Howe, 2004; McNarry et al., 2020).

Elite and high-level athletes are reported to have increased pain tolerance, and endurance athletes report lower pain intensity compared to non-athletes (Pettersen et al., 2020) which can mean that their perceptions between injury-related or exercise-induced pain and discomfort will be individualised (Bolling et al., 2019). Exercise-induced pain (EIP) represents a complex physiological and psychological phenomenon that varies significantly based on temporal and contextual factors. As demonstrated by Cook et al. (1997), EIP emerges from a combination of accumulated endogenous algesic substances and increased intramuscular pressure, with its intensity closely tied to both the duration and intensity of physical exertion (Astokorki & Mauger, 2017). This relationship becomes particularly evident in the context of professional ultra-triathlon, where athletes manage pain across multiple disciplines while simultaneously regulating their recovery processes. The pain tolerance of the elite athlete and pain perceptions can also be modulated by psychological factors such as mood, stress during training or competition, and confidence in ability to manage pain and willingness to compete or train when pain is present (Geva et al., 2013; Tesarz et al., 2012).

Indeed, a better understanding and contextualising the athlete's individual situation is paramount for targeted and optimal management and requires consideration of relevant factors that modulate the pain experience including biological, psychological, social and sport-specific and training-specific domains whether it is during competition or to promote healing time (Balk & Englert, 2020; Bolling et al., 2019; Dijkstra et al., 2014; Hainline, 2017). Gathering a better understanding of the athlete's situation will provide important information for interdisciplinary staff and athletes (Bolling et al., 2019; Hainline et al., 2017), all which can be monitored for changes over time via logbooks, diaries, interviews, and inventory questionnaires (Johnston et al., 2016; Rabitte, 2019; Saw et al., 2015).

Professional athletes operate within a distinctive cultural context where the "sport ethic" (Hughes & Coakley, 1991, 2015) establishes normative expectations for what constitutes a 'real athlete.' This ethic comprises four interrelated dimensions: making sacrifices for sport, striving for distinction, accepting risks and playing through pain, and refusing to accept limits in the pursuit of excellence. While adherence to these norms is often rewarded and valorised within sporting contexts, uncritical acceptance can lead to positive deviance - a form of overconformity where athletes exceed reasonable boundaries in ways that become dangerous and self-destructive (Coakley, 2015; Hughes & Coakley, 1991). This overconformity manifests through behaviours such as training while injured, ignoring pain signals, and prioritising performance over long-term health (Coker-Cranney et al., 2020). The sport ethic operates through narrative structures that shape athletic identity, with the 'performance narrative' representing the dominant cultural storyline in elite sport (Carless & Douglas, 2013; Douglas & Carless, 2006, 2015). This narrative constructs success through single-minded dedication to performance outcomes, where winning and achievement become inextricably linked to self-worth and identity (Ronkainen et al., 2016). Athletes who "live the

part" of this narrative may experience identity foreclosure, sacrifice relationships, and face threats to long-term wellbeing (Carless & Douglas, 2013).

Performance-based narrative identities, characterised by high perfectionism, fear of failure, and contingent self-worth, have been found to be associated with elevated psychological distress, including depression and anxiety (Bounds et al., 2024; Melton, 2024). Within this framework, pain takes on particular significance as both a marker of commitment to the sport ethic and a potential indicator of overconformity. The willingness to endure pain becomes a measure of athletic identity, creating vulnerability to overuse injuries and burnout (Boudreault et al., 2022; Bursik et al., 2024). Understanding how professional athletes navigate these cultural expectations while managing pain requires examination of the social and identity-based dimensions that complement physiological and psychological factors, thereby contributing to a comprehensive biopsychosocial understanding of pain in elite sport.

This study adopts an integrated biopsychosocial framework that extends beyond traditional psychological and biomedical approaches by incorporating sociological theories of athlete identity and culture. The biological dimension encompasses physiological pain mechanisms, training load, and injury status. The psychological dimension addresses individual cognitive appraisals, emotional responses, and coping strategies. The social dimension is conceptualised at multiple levels following Karos et al.'s (2024) framework: interpersonal relationships, positional identities related to career stage and professional status, and ideological-level cultural narratives. These frameworks enable analysis of how cultural forces shape pain experiences beyond individual psychology. Professional identity—constructed through socialisation into sporting culture—functions as a lens through which athletes interpret pain signals and make decisions about training and competition. This sociological dimension situates individual pain experiences within broader cultural contexts that systematically influence athlete behaviour.

A longitudinal, mixed methods multiple case study design provides the optimal framework for examining how professional female ultra-triathletes' pain experiences and self-regulation strategies fluctuate throughout a competitive season. While existing research has explored isolated aspects of athlete pain management, a significant gap exists in understanding how female ultra-triathletes' pain experiences vary across training cycles and competition periods, and how they self-regulate these experiences over time. This gap is particularly notable given that pain fluctuations can range from acute training-related discomfort to chronic conditions, each requiring different self-regulatory responses. These variations in pain experiences require athletes to constantly adjust their self-regulation strategies, from modifying training intensity to implementing recovery protocols, yet there is a lack understanding of how these adaptive processes occur across a competitive season. Understanding these temporal variations is crucial as they may significantly impact both immediate performance and long-term athlete wellbeing.

The advantage of this study's design lies in its ability to capture how individual biopsychosocial factors dynamically influence pain experiences and self-regulation strategies throughout the season. Specifically, this includes monitoring variations in biological factors (pain, fatigue state, training load), psychological elements (stress, mood, pain-related appraisals and expectations), and social/environmental contexts (coach responses, team dynamics, economic implications) (Grim, 2020; Hainline et al., 2017; Vleck & Bessone, 2011). This comprehensive approach aligns with current understanding of pain as a protective mechanism modulated by individual context and evidence of danger and safety, potentially guiding practitioners toward more effective, multidimensional approaches to pain management in elite female endurance athletes (Hainline et al., 2017).

The aim of this study was therefore to monitor three female professional ironman triathletes over a competitive season, using a longitudinal mixed method multiple case-study design. The following research questions were posed for the study:

1. How do professional female ultra-endurance triathletes perceive, evaluate, tolerate, and cope with their pain experiences over a competitive season?

2. How do biopsychosocial factors influence female ultra-endurance triathlete's pain experiences?

3. How does reflecting and learning from any significant pain events over the season inform future pain experiences and coping in training and competition?

## 4.2 Method

### 4.2.1 Design

To fit the aims of the study and the pragmatic worldview established in Chapter 1, this design exemplifies the transformative sequential design (Creswell & Plano Clark, 2018). Study 1's phenomenological insights were used to inform Study 2's longitudinal measurement protocols, a longitudinal mixed methods multiple case-study design. This approach was employed as a suitable approach for 'how' research questions such as for monitoring and examining the athletes pain experiences in their real-world context of competing and training over a competitive season (Baxter & Jack, 2008; Cresswell & Cresswell, 2020; Kamei et al.et al.,, 2021; Plano Clark et al., 2015; Yin, 2018). Similar designs have been effective to collect data within a real-world context (Jackman et al., 2017).

This embedded design used a convergent parallel core design to concurrently collect both QUAL + QUANT data (Cresswell & Cresswell, 2020; Yin, 2018). The use of capital letters and + sign for QUAL + QUANT denoted equal importance for collection, analysis, and interpretation stages (Cresswell & Cresswell, 2020). The convergent core design was adopted for concurrently collected quantitative and qualitative data to gain a holistic

examination looking for any convergence or divergence between participants' pain experiences throughout the season and potential environmental and biopsychosocial factors that influenced them (Cresswell & Cresswell, 2020; Onwuegbuzie & Leech, 2005). The aim of using a mixed method multiple case design was to compare different perspectives between the case studies (Cresswell & Cresswell, 2020; Yin, 2018).

The concurrent design considered recommendations on minimal burden and implementation of monitoring tools to ensure their efficacy at collecting quality, meaningful data from the ultra-triathletes in terms of frequency of completion and effective utilisation of technology (Saw et al., 2015). The self-report measures such as questionnaires and reflective diaries were an appropriate, simple, and inexpensive approach to monitoring athlete responses via online links (Halson, 2014; Saw et al., 2015) (see Figure 4.1 for the study design details).

**Figure 4.1**

*A Schematic Representation of the Longitudinal Mixed Method [Convergent Core Design]*

*Multiple Case Study Design.*
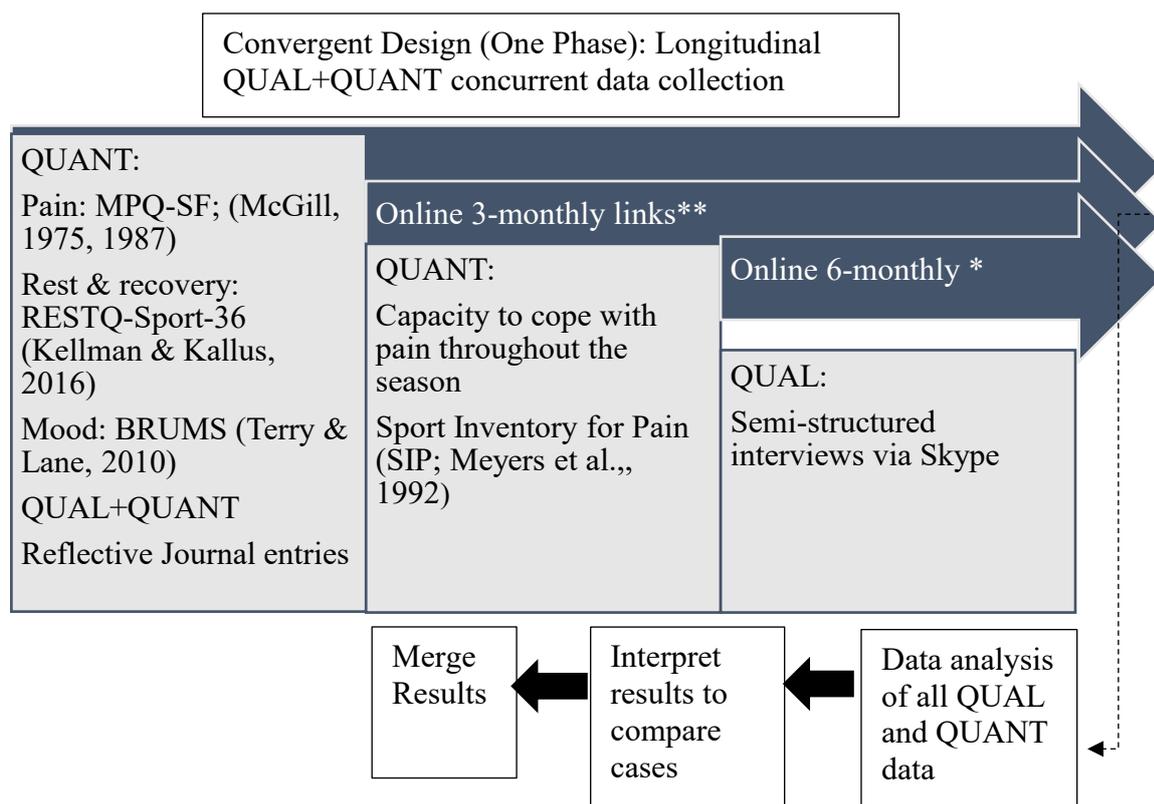
*Note***:**

***Weekly online journal and inventories 64 weeks (19 August 2019 to November 2020)

**Every 3-month online inventory links: 5x collection points (27 August 2019 to 28 August 2020)

*Three online interviews per athlete (August 2019, February 2020, and August 2020).

A summary of the monitoring tools can be found in appendix B2.7, page 404.

**4.2.2 Participants**

Following institutional ethical approval SMEC_2018-19_063, (see Appendix A.2, page 382), purposeful sampling was conducted to recruit two female professional ultra-endurance athletes via email (previous participants in study 1) which resulted in a 'snowballing effect' to recruit a third athlete (Robinson, 2014). A sample of three ultra-triathletes aligned with the recommendation in choosing a longitudinal, multiple case study design to manage the data for cross-case analysis (Yin, 2018).

Once consent was obtained, participants were contacted individually to discuss the details and expectations of the study from week 1 and throughout the QUAL and QUANT data collection links. The instructions and checking process helped participants engage effectively with the data collection tools, supporting them to share their experiences in ways that would be most useful for understanding ultra-endurance athletes' journeys. This thorough briefing process focused on establishing clear communication channels for optimal data collection while acknowledging both the value of information and experiential knowledge (Brener et al., 2003; Vinokur, 1979).

To ensure data protection, participants chose their own personalised username for the weekly emailed links. Each participant was given a pseudonym: Abbie was a 38-year-old British national living between Europe and Australasia with six years' professional racing experience; Tash was a 40-year-old British national living in Europe with five years'

professional racing experience; and Eve was a 31-year-old British national living in the UK who had just taken a Pro card in the year of starting the study.

**4.2.3 Qualitative data collection and analysis**

A longitudinal online reflective journal and three semi-structured interviews per athlete were used to collect the QUAL data and capture the temporal and evolving nature of athletes' pain experiences and perceptions across a 64-week period. This design enabled the researcher to 'walk alongside' participants (Grinyer & Thomas (2012), documenting how their understanding and tolerance of pain shifted across different training phases and competitive seasons. Multiple interview occasions allowed for deepening trust and rapport, enabling participants to progressively disclose more nuanced and reflective accounts of their pain experiences that may not have emerged in single interviews (Grinyer & Thomas, 2012). Email communication complemented the synchronous interview sessions, allowing for clarification and ongoing rapport building between formal interview occasions (James & Busher, 2012).

*Reflective Journal.*

A secure JISC online journal link was emailed to all three athletes for completion at the end of each week to reflect on their week and any learning experiences after recording pain and discomfort levels, sleep, and hours of training and competition activities (see Appendix B.2.2, page 390).

**Semi-structured interviews.**

Synchronous online interviews were conducted at 6-monthly intervals via Skype. While synchronous interviews require careful coordination of time zones and schedules, they enabled real-time dialogue and spontaneous exploration of emerging themes (James & Busher, 2012). Six-monthly intervals were chosen to allow sufficient time for meaningful changes in pain experiences and perceptions to develop whilst maintaining ongoing

engagement and minimising participant attrition (Grinyer & Thomas, 2012). The open-ended and flexible framework (Sparks & Smith, 2014) encouraged the athletes to talk about the temporal nature of significant events and any pain or discomfort experiences during their training and race experiences. The first interview (see Appendix B.2.1, page 388) followed the same schedule for all the athletes with a deliberate focus on gaining rapport starting with broad questions on individual goals and current situations within the season, followed by more specific pain-related questions dependent on the athlete responses (Cachia & Millward, 2011) (e.g., 'What are your current perceptions differences between discomfort and pain?' and 'How did you interpret any sensations or thoughts that you had from that race?').

The second and third interview schedules were open-ended within a flexible framework but context-dependent to the preliminary reading of their weekly journal entries and recapping on previous interview discussion points (Jackman et al., 2017) (e.g., 'Did you have a different perception or tolerance for pain after that break?'). The first interviews lasted between 98-120 minutes; second interviews between 50-82 minutes; and third between 48-74 minutes. All interviews were recorded and transcribed verbatim.

The reflective journal entries and three interview transcripts (QUAL data) for each athlete were analysed using the six stages of reflexive thematic analysis (Braun & Clarke, 2022). Throughout the analysis process, the researcher maintained reflexive awareness of how the longitudinal research relationship may have shaped both the data generated and its interpretation, acknowledging that rapport building and familiarity with participants' stories evolved across the study period (Grinyer & Thomas (2012). The researcher re-read the QUAL data multiple times, making notes during the open-ended coding process. Next, NVivo version 12 software was used to help collate and organise the researcher's initial codes and theme developments that were identified to elucidate the longitudinal timeline narrative. Using these initial codes, an overall concept map was created which combined the

coding of journal entries and interviews. This was combined in a cross-case analysis to define and review the generated initial themes to convey the important features and meanings of each athlete's timeline story. Finally, two overall broad themes, presented in the results section, were generated towards the integrated QUAL + QUANT findings using a weaving approach (Fetters & Freshwater, 2015).

**4.2.4 Quantitative data collection and analysis**

As illustrated in Figure 4.1, four inventories were used for monitoring the athletes, alongside the reflective journal which used numerical rating scale (NRS) style questions for collecting the QUANT data (see Appendix B.2.2, pages 390):

*Pain.*

The McGill Pain Questionnaire Short Form (MPQ-SF; McGill, 1975, 1985) was used to monitor the athletes' weekly pain sensory and affective dimensions of pain experience such as type, location, frequency, and intensity. It has been used in previous studies to examine pain during physical activities (Boat & Taylor, 2017). The questionnaire is a well-documented reliable and valid multidimensional pain assessment tool for use by clinicians and researchers, recommended for when time is limited such as for professional athletes on a busy schedule (Burckhardt & Jones, 2003; Katz & Melzack, 2011; Melzack, 1987, 2005; Strand et al., 2008; Wright et al., 2001). It was the most appropriate tool for monitoring and observing changes over time for both qualitative and quantitative assessments of pain (Chaffee et al., 2011).

Participants were presented with 15 representative words, 11 sensory and 4 affective, and asked to rank their intensity, from 0 (none) to 3 (severe). For the statement, "How bad is your present pain intensity right now? They also indicated their present pain intensity (PPI) based on the number rating scale (NRS) of 0 = no pain and 10 worst possible pain. The

athlete then completed a written description to detail the body location(s) for their pain and/or discomfort (see Appendix B.2.5 for the template, page 397).

***Mood.***

The 24-item Brunel Mood Scale (BRUMS) was used to monitor the athletes' weekly mood responses. It has six subscales (tension, depression, anger, vigor, fatigue, and confusion) of four mood descriptors each, with respondents rating how they feel "right now" on a 5-point Likert-type scale anchored by 0 = not at all and 4 = extremely (Terry & Parsons-Smith, 2021). The response timeframe used was "How do you feel right now?" The BRUMS has demonstrated satisfactory internal consistency, with Cronbach alpha coefficients ranging from 0.74–0.90 for the six subscales (Terry et al., 2003). During its development, the BRUMS showed robust psychometric properties across samples of adult students, adult athletes, young athletes, and schoolchildren (Terry et al., 2003, 2010).

Total mood disturbance (TMD) score was calculated by summing the five negative mood states (tension, anger, depression, fatigue, confusion), then subtracting the vigor score (Terry & Lane, 2010). Like other studies using triathletes (Parsons-Smith et al., 2022), the six-mood dimension raw scores were converted to T-score values, referring to an updated female athlete T-score norms table for plotting the mood profiles for weeks of high TMD, using 50 as the norm (Parsons-Smith et al., 2017, 2022; Terry & Parsons-Smith, 2021) (see Appendix B.2.4 for the template, page 395).

The six-mood dimension raw scores were converted to T-score values and plotted as mood profiles using 50 as the norm (Terry & Parsons-Smith, 2021). These profiles follow established patterns that indicate different psychological states (Morgan, 1980; Terry & Lane, 2010). An 'iceberg profile' (where vigor scores are above the norm while negative mood states fall below) typically indicates positive psychological wellbeing and optimal performance readiness. A 'submerged profile' (where vigor scores fall below norm with

negative moods near baseline) may indicate fatigue, overtraining, or insufficient recovery (Kenttä et al., 2006). An 'inverse iceberg' (where negative mood states are elevated above norm and vigor is below) often suggests psychological distress or potential burnout (Morgan et al., 1987; Parsons-Smith et al., 2022).

***Rest and recovery.***

The shorter Recovery-Stress Questionnaire (RESTQ-Sport-36) was used to monitor the athletes' weekly rest and recovery. It measured the frequency of current stress symptoms along with the frequency of recovery-associated activities and states (Kallus & Kellman, 2016). The inventory consists of twelve scales (three items per scale) that are equally balanced between four sections of overall stress, overall recovery, sport-specific stress, and sport-specific recovery.

The items of the RESTQ-sport 36 identify activities or conditions in the form of in-complete sentences, together with the standard time frame 'in the past 3 days/nights' for completion according to the Likert-type scale ranging from 0 (never) to 6 (always). The scale values were calculated by taking the mean of the item values (checked numbers; to two decimal points) and compared against the population norms for each scale where appropriate during the analysis stage (Kallus & Kellman, 2016).

In the Sleep Quality scale, the items for disturbed sleep needed to be inverted or reversed to the other scales, before calculating the score. High scores in the stress-associated activity scales reflect intense subjective stress, whereas high scores in the recovery-oriented scales reflect plenty of recovery activities. The stress and recovery scales are grouped together to provide overall calculation of Total Stress (TS) and Total Recovery (TR). For example, overall stress-oriented scale (total mean of General Stress, Social Stress, Fatigue); overall recovery-related scale (total mean of Social Recovery, General Wellbeing, Sleep Quality). Similarly, for the Sport specific stress (total mean of Disturbed Breaks, Emotional

Exhaustion, Injury) and Sport-specific recovery areas (total mean of Being in Shape, Personal Accomplishment, Self-Efficacy) (Kallus & Kellman, 2016) (see Appendix B.2.3 for the template, page 392).

Higher scores in the stress-associated activity scales reflect intense subjective stress, whereas high scores in the recovery-oriented scales reflect adequate recovery activities. The relationship between these scores provides insight into the athlete's recovery-stress state, with imbalances (high stress, low recovery) potentially indicating increased risk for overtraining syndrome, injury, or performance decrements (Kellmann & Kallus, 2001; Kellmann, 2010). Reference values derived from athlete populations (Kallus & Kellmann, 2016) were used to contextualise individual scores, with deviations from these norms serving as potential indicators of recovery-stress imbalance.

### *Coping with pain.*

The Sport Inventory for Pain (SIP; Meyers et al., 1992) was completed online every three months. It was used to examine the capacity to cope with pain throughout the season and contextualised around three types of ultra-endurance pain: race-induced muscular pain, exertional pain, and injury-related pain (Sullivan et al., 2000). The SIP is a 25-item self-report instrument that measures 5 pain-coping traits relevant to sport and clinical environments. For example, participants might respond to statements such as 'When in pain, I tell myself it doesn't hurt' (COG). Each item was scored using a 5-point Likert format ranging from strongly agree (1) to strongly disagree (5).

Trait measures were direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD). The total coping response composite score (TCR = COP + COG - CAT) serves as an overall indicator of the ability to perform mentally while experiencing physical discomfort. The raw score results were converted to T-Scores to be compared to a norm of 50 (Meyers et al., 1992) (see Appendix B.2.6 for the template, page

400). Higher TCR scores indicate more adaptive pain coping mechanisms (Meyers et al., 1992, 2001). Elevated catastrophising (CAT) scores suggest a tendency toward negative pain interpretation and potential difficulty in pain management (Sullivan et al., 2000), while higher direct coping (COP) and cognitive (COG) scores reflect more positive pain management approaches. These interpretations of SIP subscales have been validated in studies of athletes across various sports (Anderson & Hanrahan, 2008; Encarnacion et al., 2000).

### *Reflective journal.*

The athlete's subjective experiences were monitored through a weekly reflective journal (see Appendix B.2.2, page 390) that employed standardised numerical rating scales to assess multiple dimensions of pain, recovery, and performance. Three key aspects of pain experience were evaluated using a 0-6 numerical rating scale (NRS), where 0 indicated complete ability and 6 represented significant limitation. These dimensions included the athlete's capacity to tolerate pain during training and competition, the extent to which pain interfered with performance, and how psychological factors such as mood and emotions influenced their pain perception and management.

The monitoring protocol also incorporated two additional measures using 0-3 scales to track recovery markers. Sleep quality assessment considered both the continuity of sleep and the athlete's perceived rest, with scores ranging from optimal sleep (0: uninterrupted and refreshed) to poor sleep (3: interrupted and requiring more rest). Muscle stiffness was evaluated on a severity scale from none (0) to severe (3), providing insight into the athlete's physical recovery status.

### 4.2.5 Mixed methods integration

Pragmatism can be used as a guide not only for top-down deductive research design but also for grounded inductive or abductive research (Feilzer, 2010). Mixed method data

analysis in a convergent design, uses multiple case studies, integrating the separately

analysed QUAL + QUANT findings for each case (Cresswell & Cresswell, 2020). An

important approach to data integration is the use of a joint display in the form of figures,

tables, and matrices to integrate data (Fetters & Freshwater, 2015; Guetterman et al., 2015).

This comprehensive monitoring approach generated longitudinal data that was synthesised in

athlete joint display tables, which provided the detail of highlighted weeks where significant

events took place and were identified in the athlete's timeline. This systematic documentation

enabled the tracking of patterns and relationships between pain experiences, recovery

markers, and athletic performance over time.

The Reflective Journal data analysis produced a cross-case comparison of athletes'

weekly training workload (see Figure 4.2, page 161) and individual timelines (Abbie: Figure

4.3, page 162; Tash: Figure 4.5, page 168; Eve: Figure 4.7, page 173) to highlight significant

events and pain experiences over the 64-weeks. The integrated data of these significant weeks

for pain experiences and life events was collated into two individual joint display tables: a

general table (see Appendices: Abbie C.1, page 417; Tash C.4, page 424; Eve C.7, page 431)

and a race-specific table to compare their race pain/discomfort experiences (Abbie: Table 4.1,

page 163; Tash: Table 4.2, page 169; Eve: Table 4.3, page 174).

Three graphs were formulated to support these joint display tables and timeline

figures: firstly, the McGill pain sensory and affective descriptor types and their pain intensity

(see Appendices: Abbie C.2, page 422; Tash C.5, page 429; Eve C.8, page 438). Secondly,

for their longitudinal RESTQ-Sport mean values for overall and sport specific stress and

recovery scales (see Appendices: Abbie C.3, page 423; Tash C.6, page 430; Eve C.9, page

439). Third, for the longitudinal Sport Inventory for Pain (SIP) subscale T-scores

comparisons across five time points for their pain experiences and coping (see Abbie Figure

4.4, page 167; Tash Figure 4.6, page 172, Eve Figure 4.8, page 178).

### 4.2.6 Methodological rigour

#### 4.2.6.1 Research Design and Philosophical Approach

The study design was guided by a pragmatic philosophical stance, which informed the selection and integration of multiple data collection methods to comprehensively understand athletes' pain experiences. This pragmatic approach aligned with the JARS-Qual, Quant, and Mixed Methods Standards (Fetters & Freshwater, 2015; Levitt et al., 2018) and was implemented through specific rigorous procedures. Data collection rigour was established through systematic weekly journaling protocols and quarterly standardised assessments over 64 weeks, ensuring consistent and comprehensive data capture. This prolonged engagement ensured findings were rooted in the data and considered within the specific context of each participant over the longitudinal period (Braun & Clarke, 2022; Cresswell & Cresswell, 2020; Jackman et al., 2017; Levitt et al., 2018; Yin, 2018).

The research design achieved what Harrison et al. (2020) classify as high rigour mixed methods research across all framework elements. Data analysis rigour was demonstrated through sophisticated qualitative analysis (reflexive thematic analysis) combined with appropriate quantitative procedures for validated instruments. Data integration rigour was exemplified through joint display tables (Tables 4.1-4.3, pages 163,169, 174) and temporal weaving approaches, addressing Harrison et al.'s assertion that integration is "the cornerstone of mixed methods research." The explicit design identification as "longitudinal mixed methods multiple case-study design with convergent parallel core design" with visual representation (Figure 4.1, p.163) meets their high rigor criteria for design transparency, with combined insights exceeding individual component contributions.

#### 4.2.6.2 Data Collection Rigour and Ethical Safeguards

The extended 64-week duration created specific ethical considerations regarding participant burden and the potential for heightened pain awareness to influence ongoing ultra-

endurance participation, requiring careful attention to the principles of beneficence and non-maleficence (Beauchamp & Childress, 2019; Harriss et al., 2019; Palmer, 2016). The researcher ensured that each athlete from whom data was gathered longitudinally consented freely and voluntarily to participation, having had sufficient information to enable them to make an informed choice. All participants were informed that they remained free during the data collection phase to withdraw or modify their consent and to ask for the destruction of all or part of the data that they have contributed within agreed and consented limits (BPS, 2021; Vijayan, 2010). Weekly completion of inventories and reflective journals required participants to engage in systematic reflection on their pain experiences and coping approaches, potentially increasing metacognitive awareness of pain processing in ways that may have influenced competitive performance or safety considerations (Harriss et al., 2019). To minimise burden while maintaining data collection rigour, weekly data collection tools were designed for brevity and flexibility, delivered via online platforms that accommodated participants' variable training and competition schedules. This was particularly important given that all three participants were professional female ultra-endurance athletes balancing research participation with competitive careers, training demands, and other life commitments (Palmer, 2016).

The remote, digital nature of the longitudinal data collection meant that the researcher-participant relationship developed primarily through asynchronous written communication rather than face-to-face interaction (James & Busher, 2012). This created a distinctive ethical dynamic where the absence of physical co-presence may have both reduced social desirability effects and necessitated careful attention to maintaining engagement and rapport across the extended timeframe (Salmons, 2015). However, this digital distance also meant the researcher had limited capacity to observe contextual factors that might influence participants' wellbeing or willingness to disclose difficult experiences. Although equally, this

distance could have engaged a more open stance from each athlete at the six-month intervals (Grinyer & Thomas, 2012).

Ethical rigour was maintained through iterative consent processes that extended beyond initial approval. Participants received monthly check-in communications that reiterated their right to withdraw without penalty and provided opportunities to discuss their experience of the research process. The 6-monthly semi-structured interviews provided crucial touchpoints for assessing participants' ongoing willingness and capacity to continue, allowing for discussion of any concerns about research burden or unintended effects of systematic pain reflection. This approach reflects Palmer's (2016) conceptualisation of ethics as an ongoing chain rather than a single approval moment, acknowledging that participants' willingness and capacity to engage may fluctuate across extended research periods, particularly for elite athletes whose competitive calendars and physical demands vary considerably throughout an annual training cycle. The participants were reminded of their right to withdraw at any point during the 64-week study period (Grinyer & Thomas, 2012). Due to the longitudinal nature of the research, i.e., substantial commitment of time or repeated data collection sessions, renewal of consent on a weekly basis was maintained over the 64-weeks (BPS, 2021; Grinyer & Thomas, 2012).

The exclusively female participant sample also warranted consideration of gender-specific ethical dimensions. Research with female athletes requires sensitivity to the historical marginalisation of women's experiences in sport science research and the potential for research participation to intersect with gendered pressures regarding pain expression and management (Olive & Thorpe, 2011; Palmer, 2016). The shared gender identity between researcher and participants may have facilitated open discussion of pain experiences that intersect with gendered aspects of ultra-endurance participation, though these dynamics operated primarily through written rather than face-to-face communication.

### 4.2.6.3 Reflexivity and Researcher Positionality

Throughout all stages of data collection and analysis, the researcher engaged in sustained reflexivity, recognising that researcher subjectivity is an inevitable and valuable resource in qualitative inquiry rather than a limitation to be minimised (Braun & Clarke, 2022). A detailed reflexive journal was maintained to document analytical decisions, methodological choices, and the researcher's ongoing engagement with the data. The researcher's professional identity as a sports massage therapist provided valuable insider knowledge of pain management practices and athlete experiences, while also requiring careful attention to how this expertise shaped data collection and interpretation. This positioning was actively engaged with throughout the research process. During participant interviews, the researcher's therapeutic background facilitated rapport-building and enabled nuanced understanding of pain descriptions, while simultaneously requiring mindful awareness of how professional knowledge might shape question formulation and interpretation. For example, when participants described pain management strategies, follow-up questions were carefully constructed to explore participants' own sense-making rather than imposing therapeutic frameworks.

Interview transcripts and analytical notes were regularly reviewed to examine how the researcher's professional perspective influenced the interaction and interpretation, with specific attention to moments where therapeutic assumptions might be shaping understanding. Regular supervisory consultations provided critical dialogue about the analytical process, offering alternative perspectives and supporting the researcher in examining taken-for-granted assumptions emerging from professional practice. These discussions focused not on eliminating the influence of the researcher's background, but on making explicit how this positioning informed analytical choices and contributed to interpretation (Braun & Clarke, 2022).

Power dynamics in the research relationship operated across multiple dimensions, including the authority often ascribed to clinical/therapeutic roles in pain contexts. The remote nature of the research may have mitigated some aspects of these power differentials, participants could engage with research tasks in private, without the physical presence of the researcher, yet it also required particular care in written communication to ensure questions about pain experiences were not perceived as evaluative or aligned with clinical assessment rather than phenomenological inquiry. These considerations were regularly documented in the reflexive journal and discussed during supervisory meetings, ensuring that ethical considerations informed methodological decisions throughout the data collection period.

Data analysis incorporated integration between quantitative metrics (such as the SIP scores and weekly pain ratings) and qualitative insights from interviews and reflective journals, reflecting the pragmatic commitment to using multiple forms of evidence to develop robust understanding (Cresswell & Cresswell, 2020; Yin, 2018). This integration was not conceptualised as triangulation for verification purposes, but rather as a means of developing a more comprehensive and contextualised understanding of athletes' pain experiences across different modes of data (Braun & Clarke, 2022). The longitudinal design enabled observation of patterns and changes over time, with findings situated within the specific temporal and contextual circumstances of each participant's athletic season.

### 4.3 Results

The results for the three professional triathletes are presented through two broad overarching themes: 'It's part of your job - life through the lens of a pro' and 'The rise and fall of pain'. These themes reveal the complex interplay between professional identity and pain experiences, demonstrating how athletes' relationships with pain evolve across different timeline events and career stages. The integrated data from weekly journals, inventories, and interviews are presented using an interweaving approach, referring to joint display tables,

graphs, and timelines of significant events (Fetters & Freshwater, 2015). While individual

case analyses are presented, the focus is on highlighting unique aspects of each athlete's

experience rather than repeating similar observations. Figure 4.2 (page 161) provides a cross-

case comparison of the three triathletes' longitudinal weekly training workload, clearly

illustrating the fluctuations in training volume that correspond with injury periods, race

events, and COVID-19 lockdown. This visual representation helps contextualise the

subsequent findings by showing how training patterns directly relate to significant timeline

events.

As an overview, before examining individual cases, several important patterns of

convergence and divergence became apparent across all three athletes. First, all demonstrated

fluctuating pain tolerance influenced by biopsychosocial factors, particularly mood, sleep

quality, and recovery status. Second, all athletes distinguished between (un)familiar and

expected training/race pain and potentially harmful injury pain, though their frameworks for

this evaluation varied. Third, the longitudinal data highlighted that pain management

strategies evolved over time in response to injury experiences, competitive demands, and

career development.

The integration of quantitative measures (BRUMS, RESTQ-Sport, McGill Pain

Questionnaire, and SIP) with qualitative data consistently showed how pain experiences

corresponded with timeline events. For example, mood profiles typically shifted from iceberg

to submerged or inverted patterns during periods of injury or overtraining, while McGill pain

descriptors became more severe and affective rather than merely sensory during these

periods. The race-specific joint display tables (Tables 4.1-4.3, pages 163, 169, 174) provide

comprehensive integration of multiple data sources that showed how each athlete experienced

and managed pain during competitions. Table 4.1 illustrates how Abbie's pain experiences

evolved from her early post-injury race (week 2) through to her virtual race adaptation (week

50), with notable changes in her ability to differentiate between performance-related discomfort and injury pain. Table 4.2 demonstrates Tash's contrasting experiences between lower priority (week 10) and high priority (week 15) races, particularly in how motivation and race context influenced her sensory and affective pain descriptors. Table 4.3 captures Eve's developmental journey as a neo-professional, showing how her pain interpretation framework evolved from early uncertainty (weeks 3-10) to more nuanced management strategies in later races (weeks 48-56). Together, these tables highlight the individualised and context-dependent nature of race pain experiences across different career stages.

**Figure 4.2**

*Cross Case Comparison of Three Triathletes' Longitudinal Weekly Training Workload. Source: Reflective Journal*

**Figure 4.3**

*Case Study 1: Abbie's Timeline of Significant Events. Source: Reflective Journal*



Key: LP=low priority; MP=medium priority; HP=high priority. NC=New coach; Light grey dashed arrow= race & training experiences; dark grey dashed arrow=pain related experiences.

Race phase:
Week 2 LP (1st race post-shoulder injury), Week 5 HP, Week 9 HP, Week 13 LP, Week 15 MP, Week 17 NC. Week 18 MP.

Week 20-24 Rehab/limited training at group training camp. Weeks 26-30 rehab/rest.

Weeks 33-42. Training/rehab mainly indoors under UK restrictions. Week 49 Slow healing still no swimming allowed.

Virtual race phase:
Week 37 virtual bike event; Week 50 HP virtual bike race; Week 53 100-mile time trial

Week 57 finally started swimming.

Week 52: 'it's a real struggle to get through training when not getting enough sleep'.

Race phase:
Week 59 Race 2.5hrs

Week 62 Spain introduces national curfew due to covid resurgence.

Week 64 Travel relocation to Spain from UK for training.

Weeks 2-20 Travel for races, relocation for winter, and training camp.

Weeks 33-42 Covid-19 Pandemic Global Lockdown in UK. All races cancelled.

Week 58 UK Government introduces new restrictions.

Week 63 2nd Covid Lockdown in UK starts. Races cancelled.

Week 9 'Discomfort always comes during a race. I wasn't able to push harder to get through and let it control my level of effort rather than me trying to control it.'

Week 19 original plate removed form clavicle. Feels sore. Weeks 20-25 tightness in shoulder/neck area mainly during swimming.
Week 26 stress fracture diagnosed in same area after plate removal.
Week 30. Finds out bone not healing and misaligned. 'you don't know what you've got until you've lost it.'
Week 31 2nd new plate re-inserted into clavicle before full global lockdown.

Weeks 30-64 pain intensity decreases to zero with mainly just aching noted in journal. Aching is normalized.

162

**Table 4.1**

Case Study 1: Abbie's Longitudinal Integrated Data for Race Pain/Discomfort Experiences and Coping

| ABBIE | Race Week 2 (Low Priority) | Race Week 5 (High Priority) | Race Week 9 (High Priority) | Race Week 13 (Low Priority) | Week 50 Virtual bike race (High priority) |
|---|---|---|---|---|---|
| **Journal QUAL** which factors affected tolerance levels | It was mild so more just noticing it that having to manage or do anything about it | Racing an Ironman - so always levels of discomfort on the bike and run | n/a | Ability to tolerate slight knee pain on the bike, was probably because I still felt strong and power was flowing, so could manage the slight discomfort as still felt strong. Struggle in the run always to break down the barriers and push | Race situation - virtual race - somehow you manage to push through and was more like an interval session than full on for 2.5 hours. As well as lots of interaction with commentators [No real pain – discomfort a bit in |

| | | | | through the discomfort. | the race due to the effort involved – not really pain related though] |
|---|---|---|---|---|---|
| **Journal QUAL** how managed discomfort and/or pain | "It [left lower back] was mild ache so very able to tolerate it during the race. | Sometimes you can push through, other times you let discomfort win and continue to tick along. On the bike sometimes you know you have to push to stay with a group which is perhaps more uncomfortable than you'd like. | "Discomfort always comes during a race. But you just get on with it somehow. I probably wasn't able to push harder to get through and let it control my level of effort rather than me trying to control it." week 9 | "On the bike - just kept focusing on what I was doing, e.g. riding my bike strongly and well and where the other women were rather than any knee pain." week 13 | As above |
| **McGill Pain Inventory QUAL** | "Quads mainly, slight ache lower back, slight ache shoulders" McGill wk2 | "No pain but ache and discomfort - quads, calves, toes/toenails" McGill wk5 | "Tight shoulders - probably from travel.  Aching middle of the back. either side of spine" McGill wk9 | "No real pain". McGill wk13 | Usual collar bone aching |
| **McGill Pain Inventory QUANT** Descriptors: 11 Sensory 4 Affective Intensity level: none, mild, moderate, severe | Sensory (5/11): mild throbbing mild cramping moderate aching moderate heavy mild tender | Sensory (5/11): mild throbbing mild cramping moderate aching moderate tender | Sensory (2/11): mild aching mild tender | Sensory (4/11): mild cramping moderate aching moderate heavy mild tender | Sensory (1/11): mild aching |

| | | Affective (1/4): mild tiring-exhausting | | Affective (1/4): mild tiring-exhausting | |
|---|---|---|---|---|---|
| McGill Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe | 5 | 7 | 2 | 2 | 1 |
| **McGill** NRS PPI Ratings: 0-none; 10=worst possible | 3 | 0 | 0 | 0 | 0 |
| Journal QUANT for pain/discomfort: 6=not all; 0=completely<br>1. Ability to tolerate<br>2. Performance affected by interference of<br>3. Mood/emotions influenced perceptions/control of | 1. Pain 4/6; discomfort 4/6<br>2. Pain 2/6; discomfort 2/6<br>3. Pain 2/6; discomfort 3/6 | 1. Pain 2/6; discomfort 2/6<br>2. Pain 6/6; discomfort 2/6<br>3. Pain 3/6; discomfort 3/6 | 1. Pain 2/6; discomfort 1/6<br>2. Pain 6/6; discomfort 6/6<br>3. Pain 4/6; discomfort 3/6 | 1. Pain 1/6; discomfort 1/6<br>2. Pain 6/6; discomfort 3/6<br>3. Pain 6/6; discomfort 3/6 | 1. Pain 0/6; discomfort 0/6<br>2. Pain 6/6; discomfort 6/6<br>3. Pain 6/6; discomfort 6/6 |
| **BRUMS** Mood profile/Total Mood Disturbance raw score (TMD)/ Vigor dimension T-Score | Inverse iceberg<br>TMD 21<br>Vigor 28 | Inverse iceberg<br>TMD 9<br>Vigor 36 | Inverse iceberg<br>TMD 10<br>Vigor 28 | Submerged<br>TMD -2<br>Vigor 45 | Submerged<br>TMD 5<br>Vigor 39 |
| **RESTQ**<br>Total Recovery (TR)<br>Total Stress (TS)<br>Injury subscale (IS)<br>(reference value norm 2.4) | TR 10.33<br>TS 10.67<br>IS 3.33<br>GWS 2.00 | TR 14.33<br>TS 7.33<br>IS 2.00<br>GWS 2.33 | TR 11.33<br>TS 8.33<br>IS 2.00<br>GWS 2.00 | TR 14.33<br>TS 7.67<br>IS 1.67<br>GWS 2.00 | TR 11<br>TS 7.33<br>IS 1.67<br>GWS 2.00 |

| General Wellbeing Subscale (GWS) (reference value 3.8) | | | | | |
|---|---|---|---|---|---|
| **SIP** 1st Timepoint (week 2) Total Coping Response (TCR) | 51 | n/a | n/a | n/a | n/a |
| **Journal** weekly reflections on experiences. | Not necessarily new - but I wasn't good enough to compete off the back of my injury. We did kind of know this, but you still hope that something will spark. But it was disappointing. | None | None | For this race, I had a completely relaxed or different approach. Going with the flow of someone else schedule (due to transport) and being fine with that. Not necessarily going through my usual OCD tendencies - I think it made it a lot less stressful:-) | I surprised myself with how much I enjoyed the race and week and buzz |

**Figure 4.4**

*Case Study 1: Abbie's Sport Inventory for Pain (SIP) T-Score Results*
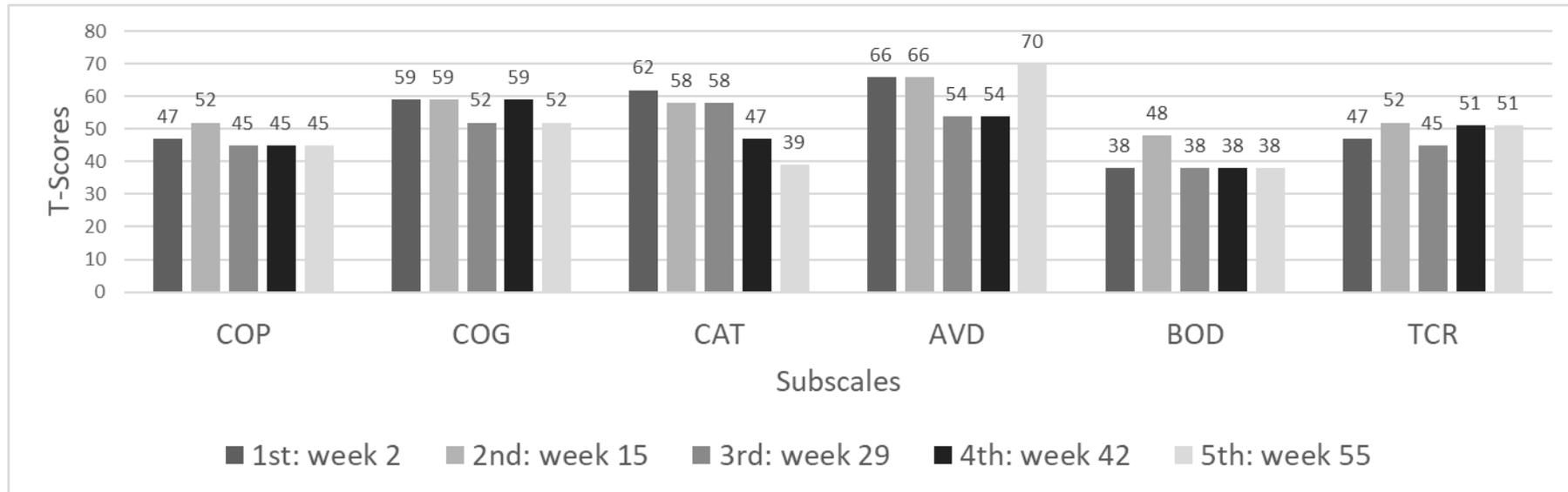


*Note:* direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al., 1992). Total coping response score (TCR = COP + COG - CAT) which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain.

**Figure 4.5**

*Case Study 2: Tash's Significant Events Timeline. Source: Reflective Journal*



Training reflection: Week 6 'without adequate sleep I can't recover and train hard. The heat here is making sleeping hard'.

Race Phase:
Week 10 LP 11th
Week 15 HP 9th.

Weeks 5, 11, 19 Travel. Weeks 12 & 21 caught cold. Week 17-18 Holiday no data

Weeks 1–13-foot, knee & SIJ/Hip noted; Week 4 & 10 jellyfish stings during swim; Week 15 deep post-race fatigue & saddle sore.

Week 24 1st MRI by consultant on Hip area; no bone injury diagnosed.

Training reflections: Week 31 'never take freedom for granted'; Week 32 'I still want to beast myself every day'. Week 39 angry at covid stopping freedom. Week 32 still want to beast myself.

Training indoors due to restrictions

Weeks 29-36 Covid-19 Pandemic Global Lockdown Spanish restrictions. Races cancelled.

Week 27 pushes overtraining envelope and damages rib intercostal.

Week 51 No data, realizes overdoing training within treatment. Week 57 Walk/run program; Week 61 Long run and over did it.

Weeks 51-52 holiday
Weeks 45, 54, 61 Travel.

Week 45 2nd MRI by consultant. Diagnosis hamstring tendinopathy. Weeks 49-50, 61-64 Shockwave treatment and EMTT for injury

Weeks 36-39 hip/SIJ and neck pain noted. Weeks 42-47, & 51 hamstring issue noted. Weeks 59-60, 62, 64 hamstring issue persists despite treatment.

Key: LP=low priority; MP=medium priority; HP=high priority. Light grey dashed arrow= race & training related experiences; dark grey dash arrow=pain related experiences.

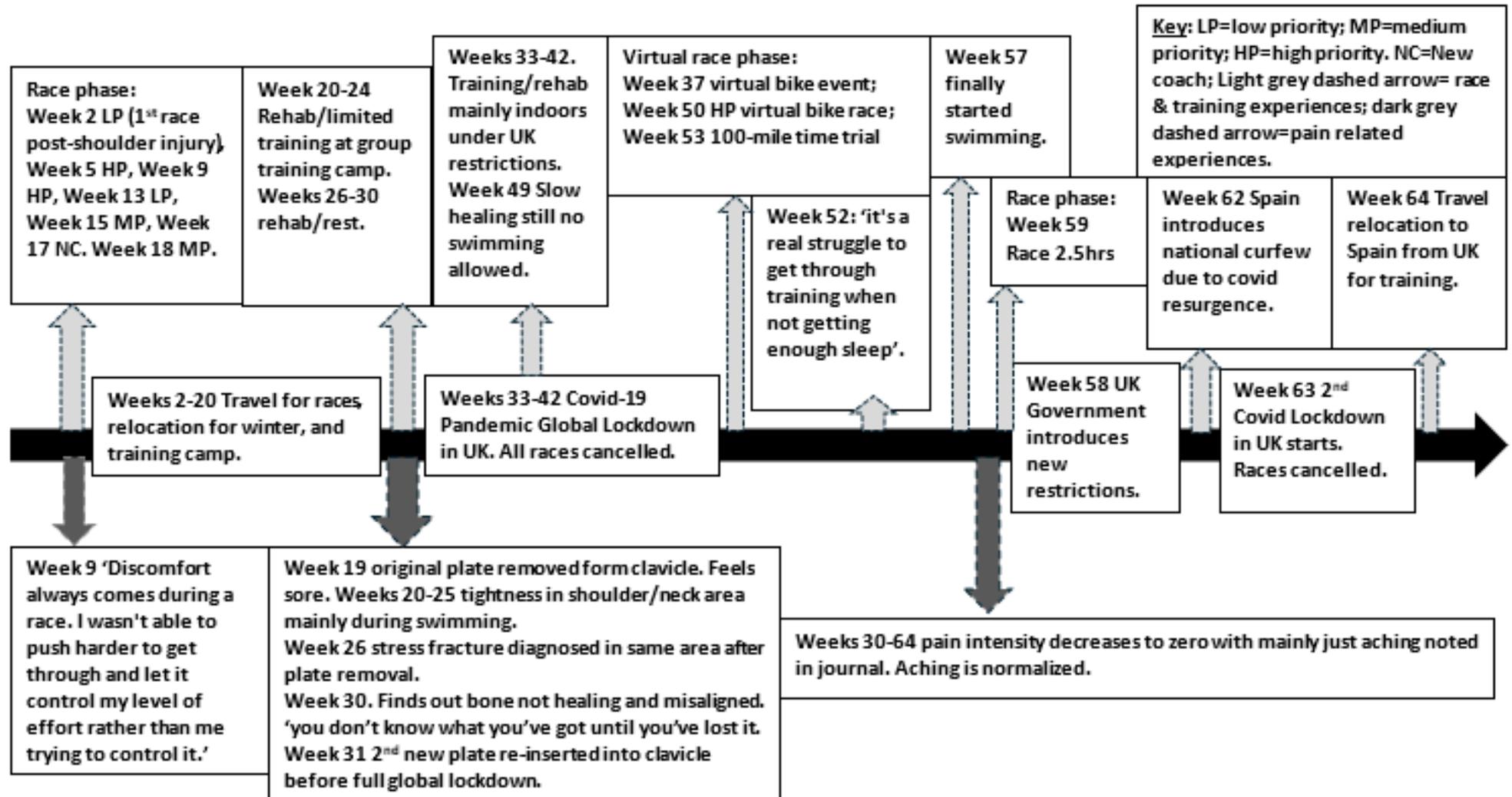Week 62 Spain introduce national curfew due to covid resurgence. All races cancelled.

**Table 4.2**

Case Study 2: Tash's Longitudinal Integrated Data for Race Pain/Discomfort Experiences and Coping

| TASH | Race Week 10 (Low priority – 11th place) | Race Week 15 (High priority 9th place) |
|---|---|---|
| **Journal QUAL** which factors affected tolerance levels | I was unable to really push hard in the race. It was like I had a limiter on my heart rate. I don't know who, but it could have been because my race started with a bad swim and then I was feeling quite unmotivated on the bike. But I was not able to generate the usual amount of power on the bike that I can, so the discomfort in my legs was bad but not as bad as it can be. | I was not able to tolerate the discomfort on the marathon in the way I would have liked. My mind felt weak. I think this is because I did not have a strong enough "why" for overcoming the pain. I did not care enough about the outcome - although after on reflection is does not feel that way as I care a lot now and am being especially hard on myself. But in the moment, in the race, I didn't care enough to overcome that all-encompassing discomfort which was screaming at my body to stop. |
| **Journal QUAL** how managed discomfort and/or pain | In a race it's not possible to manage it really - you just have to mentally accept the pain and push through it. But I was not really able to do that during this race. | I had lots of management strategies prerace and during, mainly mental to cope with the discomfort. On the run I had triggers to keep my brain on track, but they were too weak for the overwhelming fatigue. I also used ice, water, and nutrition during the race to manage the discomfort, in the oppressive heat of the day! Certainly, the cooling strategies worked, and I never felt like I was overheating too much. I just couldn't run fast. |

| McGill Pain Inventory QUAL | Lower back on right, stiff and throbbing. Right ankle - slightly sprained in the race and has ached this week a little | So, this week was Ironman week. And basically, everything hurts during and after a race like this, especially in the heat. I had left Achilles pain pre-race, but it was fine on race day and only slightly stiff after. I have quite severe right knee pain after, and it has lasted a few days and continues. Not unusual. During the race I had the usual neck and shoulder pain on the bike - like being in a stress position for an extended period of time. Then on the run just very heavy legs and painful feet |
|---|---|---|
| **McGill Pain Inventory QUANT** Descriptors: 11 Sensory 4 Affective Intensity: none, mild, moderate, severe. | Sensory (6/11): mild throbbing mild hot-burning mild cramping mild aching mild heavy mild tender<br><br>Affective (1/4): mild tiring-exhausting | Sensory (6/11): moderate throbbing moderate sharp mild hot-burning moderate aching severe heavy severe tender<br><br>Affective (3/4): severe tiring-exhausting moderate sickening moderate punishing-cruel |
| **McGill** Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe | 7 | 20 |
| McGill NRS PPI Ratings: 0-none; 10=worst possible | 0 | 3 |

| **Journal QUANT** for pain/discomfort: 6=not all; 0=completely | 1. Pain 5/6; discomfort 2/6<br>2. Pain 1/6; discomfort 3/6<br>3. Pain 2/6; discomfort 2/6 | 1. Pain 0/6; discomfort 0/6<br>2. Pain 6/6; discomfort 2/6<br>3. Pain 6/6; discomfort 0/6 |
|---|---|---|
| 1. Ability to tolerate<br>2. Performance affected by interference of<br>3. Mood/emotions influenced perceptions/control of | | |
| **BRUMS** Mood profile/Total Mood Disturbance raw score (TMD)/ Vigor dimension T-Score | Iceberg<br>TMD -9<br>Vigor 61 | Iceberg<br>TMD -10<br>Vigor 64 |
| **RESTQ**<br>Total Recovery (TR)<br>Total Stress (TS)<br>Injury subscale (IS) (reference value norm 2.4)<br>General wellbeing subscale (GWS) (reference value 3.8) | TR 16.33<br>TS 6.0<br>IS 4.0<br>GWS 1.00 | TR 18.67<br>TS 8.67<br>IS 4.33<br>GWS 1.0 |
| **SIP** 1st Timepoint (week 2) Total Coping Response (TCR) | n/a | 52 |
| **Journal weekly reflections** on experiences. | I was disappointed with my race. I am still not sure what I have learnt from it. But I think I was not tapered enough - and as I am getting older, I need a longer taper than I used to. | I knew this going into the race- but in a superficial way. It is impossible to run a fast marathon unless you really want it. You have to have a deep-seated reason to do that or your body's survival system wins. I think my body could have run faster if my brain wanted it enough. |

**Figure 4.6**

*Case Study 2: Tash's Sport Inventory for Pain (SIP) T-Score results*
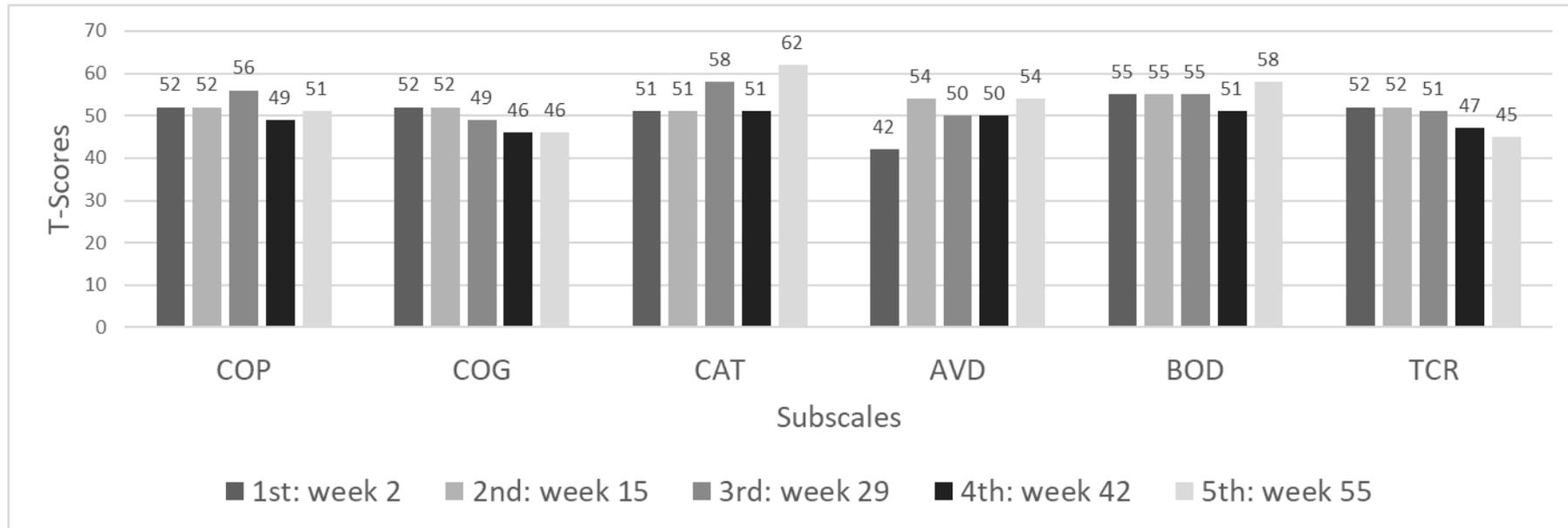


*Note*: direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al., 1992).
Total coping response score (TCR = COP + COG - CAT) which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain.

**Figure 4.7**

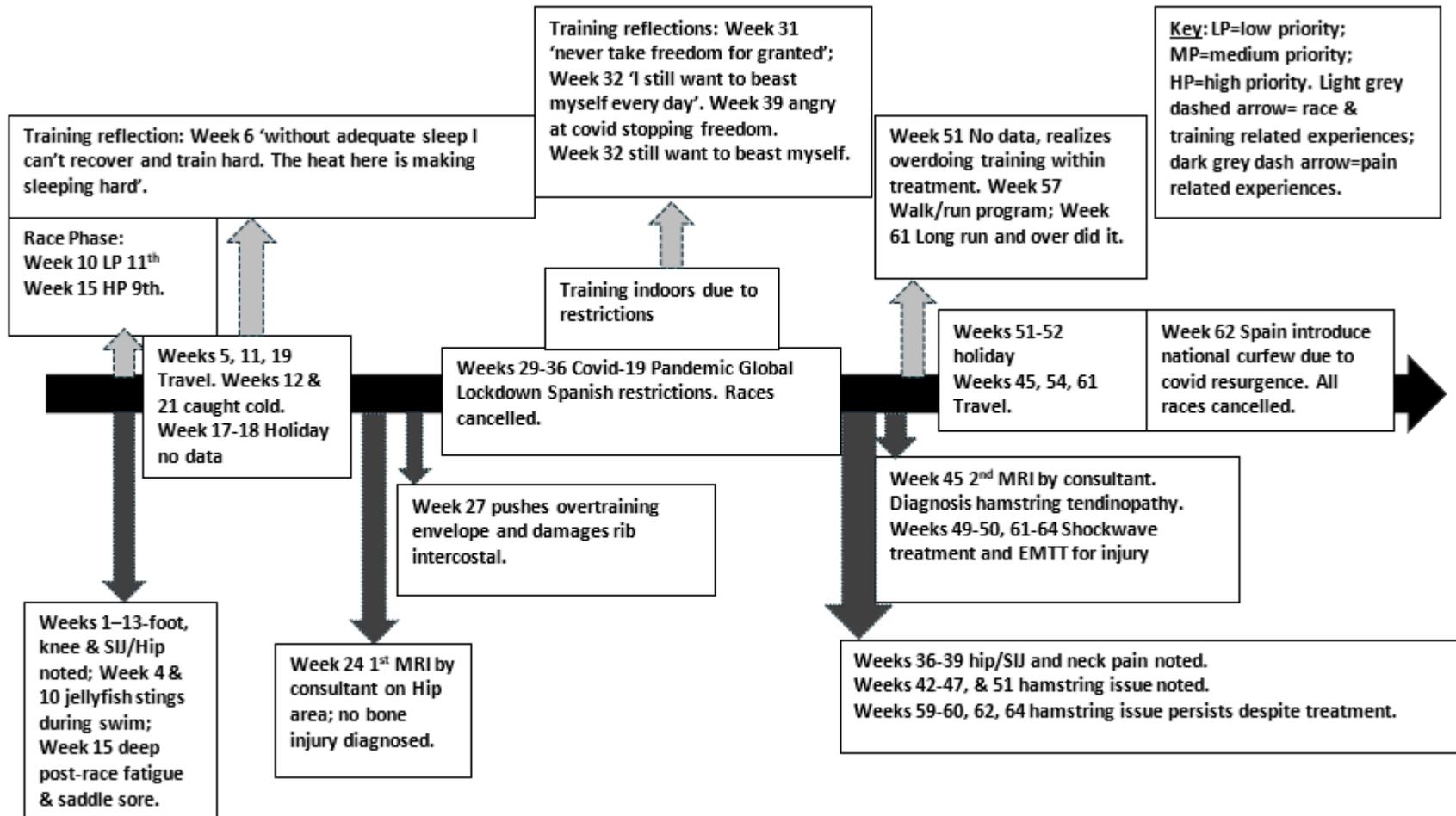*Case Study 3: Eve's Timeline of Significant Events. Source: Reflective Journal*



Key: LP=low priority; MP=medium priority; HP=high priority. NC=new coach; Light grey dotted arrow= race & training experiences; dark grey dash arrow=pain related experiences.

Week 2 Training camp

Race phase: Week 3 LP (9th); Week 8 LP (6th)); Week 10 DNF Week 11 New coach.

Week 31 Training Camp cut short.

Week 36 Virtual ride with friends. Week 37 Zwift training ride with others

Week 19 Started running.

Race phase: Week 48 Virtual Mountain run; Week 53 LP; Week 56 HP (5th)

Week 61 LP Time Trial. Race build but possibility of race cancellation.

Weeks 33-42 Covid-19 Pandemic Global Lockdown in UK. All races cancelled.

Week 50 Holiday week; no data.

Week 58 UK Government introduces new restrictions.

Week 63 2nd Covid Lockdown in UK starts. Races cancelled.

Week 1-11 Foot injury from running noted. Week 1 Feeling drained fatigued and not rested after 'A' race. Week 10 feeling lethargic; heart rate too high during race.

Week 12 Medical diagnosis of stress reaction in heel. Races cancelled for rehab Weeks 12-25 Rehabbing foot. Weeks 14-20 Shoulder sore from swimming.

Week 42 Fell off mountain bike – leg pain.

Week 57 Calf strain; sees Osteopath for first time.

Week 59 Needs time out from training for physical and mental well-being.

Week 63 Little bike crash. Swollen right knee and few grazes.

Week 49 post mountain run: exceptionally sore quads, severe discomfort, pain in my left calf. 'Pain barrier moves out when you're enjoying yourself and 'want' to do it' 'epic day out - so its ok to hurt for pain'.

173

**Table 4.3**

Case Study 3: Eve's Longitudinal Integrated Data for Race Pain/Discomfort Experiences and Coping

| EVE | Race Week 3 (Low Priority – 9th place) | Race Week 8 (Low Priority 6th place) | Race Week 10 (Low Priority - DNF) | Race Week 48 (Virtual Mountain run – low key) | Race Week 56 (High Priority 6th place) |
|---|---|---|---|---|---|
| **Journal QUAL** which factors affected tolerance levels | I felt good in the most part being able to tolerate pain this week - however, from a running perspective I have a heightened doubt in my ability / have been worried about HR being higher than normal for the pace during the week which has stopped me wanting to push too hard. Seem to be more | I was keen to race and was definitely able to race mentally this week. I felt like I had showed up and was able to push myself well despite it being a hard day out | my head wasn't in the right space to push through the pain barriers in test ride and race. I didn't have the va va voom and I felt under the weather / lethargic and like I wasn't good enough to be racing. | very able to tolerate pain and discomfort this weekend as I was in one of my favourite training locations and not at home | n/a |

| | | | | | |
|---|---|---|---|---|---|
| | able to tolerate discomfort when biking again (especially in the race) - would indicate fatigue has dropped back from "X" A race. | | | | |
| **Journal QUAL** how managed discomfort and/or pain | Stopped running / slowed the pace to something more comfortable and what was within my 'perceived' limits - however, this was bounded by confidence and mind limitation. This helped a lot - but obviously not a good way to hit pace targets / race week and perform. | I just told myself that I wanted to do well in the race and that if I kept going, I might make up places | I stopped. and listened to my body and all the signs. which is the best thing that I could have done | just broke it down | just stretched and kept moving |
| **McGill Pain Inventory QUAL** | Still issues with left plantar. right seems good now - had a little ache in the right heel after racing, quads pretty | Plantar and left foot pretty sore this morning after racing. Quads heavy after racing. Otherwise - feel pretty good | I have a pretty sore lower back (this is a dull achy pain) and my left plantar has kicked off the last few days therefore taking a little break | My quads are pretty fatigued and tender from yesterday's uber run in the mountains. my left calf a little | n/a |

| | heavy from training load. slightly tight calves from training. lower back a little achy | | from running. This is more immediate discomfort and localised to the underside of the foot | tweaky. my glutes are also sore. but all good sore (apart from the calf) | |
|---|---|---|---|---|---|
| **McGill Pain Inventory QUANT** Descriptors: 11 Sensory 4 Affective (none, mild, moderate, severe) | Sensory (4/11) mild cramping moderate aching moderate heavy mild tender  Affective (1/4): mild tiring-exhausting | Sensory (3/11) mild aching mild heavy mild tender  Affective (1/4): mild tiring-exhausting | Sensory (4/11) moderate aching moderate heavy mild tender.  Affective (1/4): moderate tiring-exhausting | Sensory (3/11) mild aching mild heavy mild tender.  Affective (1/4): moderate tiring-exhausting | Sensory (1/11) mild aching  Affective (1/4): mild tiring-exhausting |
| **McGill** Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe | 7 | 4 | 7 | 4 | 2 |
| **McGill** NRS PPI Ratings: 0-none; 10=worst possible | 2 | 2 | 4 | 3 | 0 |
| Journal QUANT for pain/discomfort: 6=not all; 0=completely 1. Ability to tolerate 2. Performance affected by interference of 3. Mood/emotions influenced | 1. Pain 2/6; discomfort 1/6 2. Pain 5/6; discomfort 2/6 3. Pain 2/6; discomfort 5/6 | 1. Pain 1/6; discomfort 1/6 2. Pain 5/6; discomfort 5/6 3. Pain 5/6; discomfort 5/6 | 1. Pain 4/6; discomfort 4/6 2. Pain 1/6 discomfort 2/6 3. Pain 1/6; discomfort 5/6 | 1. Pain 0/6; discomfort 0/6 2. Pain 6/6; discomfort 6/6 3. Pain 6/6; discomfort 6/6 | 1. Pain 1/6; discomfort 1/6 2. Pain 5/6; discomfort 5/6 3. Pain 3/6; discomfort 3/6 |

| perceptions/control of | | | | | |
|---|---|---|---|---|---|
| **BRUMS** Mood profile/Total Mood Disturbance raw score (TMD)/ Vigor dimension T-Score | Submerged TMD 2 Vigor 31 | Submerged TMD -1 Vigor 34 | Submerged TMD 1 Vigor 36 | Submerged TMD 2 Vigor 28 | Submerged TMD 1 Vigor 31 |
| **RESTQ** Total Recovery (TR) Total Stress (TS) Injury subscale (IS) (reference value norm 2.4) General Wellbeing Subscale (GWS) (reference value 3.8) | TR 15.67 TS 8 IS 4 GWS 0.0 | TS 29 TS 3 IS 5.3 GWS 0.0 | TR 19 TS 12.33 IS 4.33 GWS 1.67 | TR 29.67 TS 0.33 IS 4.67 GWS 0.0 | TR 28.33 TS 1.33 IS 5.00 GWS 0.0 |
| **SIP** 1st Timepoint (week 2) 5th timepoint (55) Total Coping Response (TCR) | 68 | n/a | n/a | n/a | 53 |
| **Journal weekly reflections** on experiences. | The mind is a really powerful restrictor of performance | That your mind really has to be in the right place to race | Listen to your body and the signs. | I really needed to be away from home for a bit. feel so much better for a few days away | It's good to have a goal and finally race |

**Figure 4.8**

*Case Study 3: Eve's Sport Inventory for Pain (SIP) T-Score results*
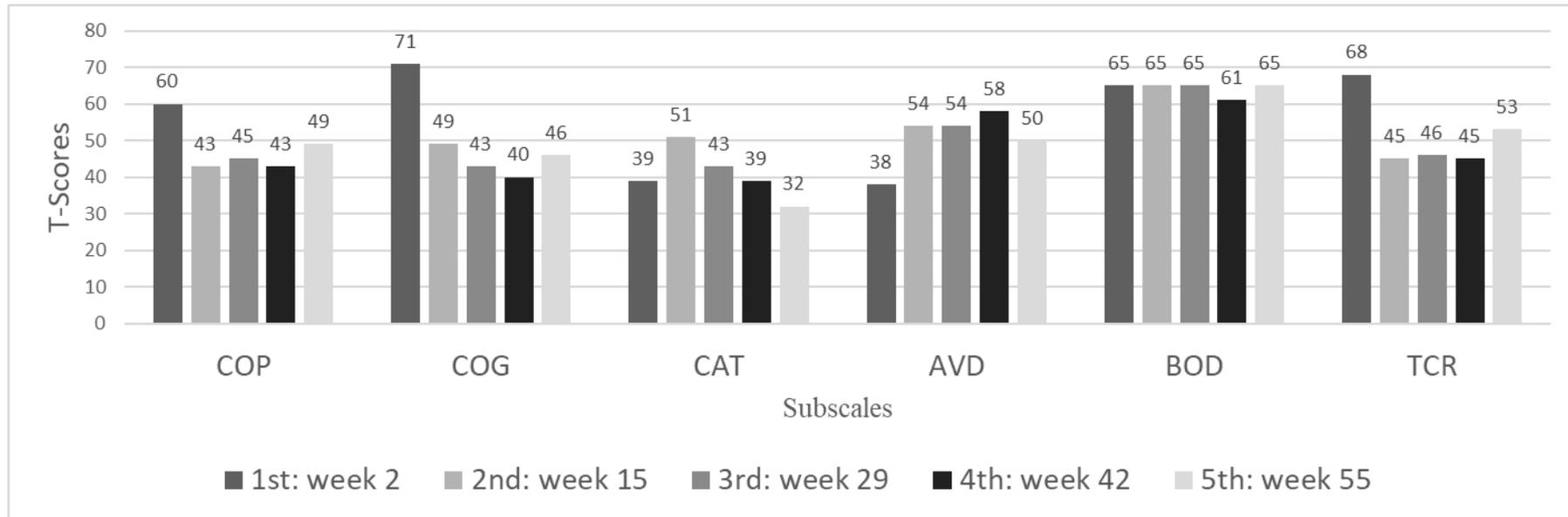


*Note*: direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al., 1992). Total coping response score (TCR = COP + COG - CAT) which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain.

### 4.3.1 Theme 1: It's part of your job - life through the lens of a pro

The first theme represented the different mental and physical pressures of trying to prove themselves as professional triathletes and how this influenced their individual pain experiences during high intensity competing and training. Professional identity shaped pain interpretation and management strategies across the 64-weeks, though this relationship manifested differently according to career stage, as detailed in the individual cases below. The professional pressures documented across all three athletes align with what Hughes and Coakley (1991) conceptualised as the "sport ethic" set of norms emphasising sacrifice, distinction, risk acceptance, and refusing limits. Recent research by Bursik et al. (2025) extends this framework by demonstrating how elite athletes actively construct and modify their risk perceptions throughout their careers, rather than simply accepting culturally imposed norms. This constructivist perspective aligned with the longitudinal patterns observed in the current study, where professional identity shaped pain interpretation and management strategies across the 64 weeks in ways that reflected both conformity to and, at times, overconformity to these cultural expectations (Coker-Cranney et al., 2018; Mayer & Thiel, 2018; McGee et al., 2024). This overconformity manifested as what Carless and Douglas (2013) termed living the part of athlete, where performance-related concerns infused all areas of life while other dimensions were diminished or relegated. The longitudinal data illustrated how this cultural framework created both the motivation to endure pain and the vulnerability to dangerous levels of pain tolerance that ultimately led to overuse injuries.

The longitudinal data highlighted clear patterns in how various stressors influenced pain experiences across the season. Training workload data (Figure 4.2, page 161) corresponded with timeline events such as overtraining, injury and rehabilitation periods, and COVID-19 lockdown (see Figures 4.3, page 162; 4.5, page 168; and 4.7, page 173). These

temporal patterns suggest that professional ultra-triathletes must constantly recalibrate their relationship with pain based on training phase and competitive demands.

Although the participants were at different stages of their career, success at achieving their performance goals was attributed to seeing the bigger picture and accepting that experiencing pain and discomfort was part of their job: "Managing that interface of pain or discomfort boils down to how much you want to absorb cos you know that discomfort is gonna make you better, faster, or win the race" (Tash, Interview 1). This extract illustrates the volitional nature of pain in professional ultra-endurance sports—athletes need motivation to voluntarily hurt in pursuit of performance goals.

### Career Stage and Pain Management: Individual Case Analyses

Eve's early career experiences showed how transitional pressure could lead to overtraining, while Tash's established professional status enabled more strategic pain management decisions. Abbie's experience with injury demonstrated how even experienced professionals must recalibrate their relationship with pain during setbacks. These variations suggest that pain management strategies evolve with professional development and experience.

**Eve: The Neo-Professional.** Eve's initial expectations and reality of finally becoming a professional were not matching up. Struggling to cope with jumping straight into the fast-paced and high-intensity lifestyle, left her feeling like she had: "Gone right back to the beginning" as an age grouper in building up her pain efficacy for the higher race demands:

> I've got my pro card I should be racing at the sharp end but realistically I'm not going to be in my first season because I'm racing a completely different set of girls now in terms of like their strengths and their specialties. I've just got to be aware of that, to not let it mentally drain me because it was almost starting to a bit while I was trying to get the body and brain aligned. (Interview 1)

Eve's disappointment in her overall rookie performances and unrealistic expectations made her panic: "Because I've always wanted to do it even though it hurts and even though it's hard, it's like it doesn't matter, I still want to do it, there was still the drive there and you push on". She realised that she would never succeed at this level if the drive to hurt had already disappeared so soon in her first year. Eve's experiences exemplified the pressures of establishing a performance-based narrative identity, where her sense of self-worth became contingent upon race outcomes and professional status. This identity foreclosure, where athletic identity dominated all other self-aspects, created the conditions for positive deviance through overconformity to professional training demands. Her journal entries illustrated the normalisation of pain as proof of commitment to the sport ethic, while simultaneously revealing how this uncritical acceptance of pain led to ignoring injury warning signs from week 1 onwards. Looking at the joint display table 4.3 (page 173), subsequent race attempts in week 8 and 10 displayed differences in her drive to hurt and highlighted how an imbalanced mental and physical wellbeing could affect her ability to control the performance outcome. Her week 8 journal entry read: "I was keen to race and was definitely able to race mentally this week. I felt like I had shown up and was able to push myself well despite it being a hard day out". This was supported by her week 8 RESTQ Total Stress (TS) score being low at 3 and Total Recovery (TR) score was high at 29, with a BRUMS Total Mood Disturbance (TMD) of -1 (see Appendix Table C.7, page 431 for complete physiological and psychological metrics). This data profile indicated a positive recovery state despite displaying a submerged mood profile with vigor below the norm of 50, suggesting lingering overtraining effects from her earlier season (as documented in her diary entries from weeks 1-7). Yet two weeks later:

My head wasn't in the right space to push through the pain barriers in test ride and race. I didn't have the va va voom and I felt under the weather / lethargic and like I wasn't good enough to be racing. (week 10, Journal)

The diary entry confirmed her feeling of being overtrained with the drop in RESTQ TR to 19 and increase in TS to 12.33 and BRUMS vigour remaining below the norm of 50, confirming the importance of self-regulating sufficient rest and recovery during high intensity periods of training and racing.

Eve's mental and physical pressures were underlying to her wanting to prove herself in her first year with the media and her personal expectations reached saturation point by week 12 (see Table 4.3, page 174 and appendix C.7, page 431; Figure 4.7, page 173), when an overuse foot injury she had ignored since week 1, had progressed into a stress reaction. Figure 4.2 (page 161) highlighted the workload of hours training in the build up to week 12 and supported Eve's journal entries with feeling fatigued and overtrained. The injury-related pain stopped all future racing and training, meaning the chances to perform well enough to gain sponsorship offers were now on pause. This left her with financial pressure of continuing to work a 4-day week to pay for all the expenses of being an ultra-triathlete. The rehabilitation period allowed Eve to reflect on her high expectations which led to her overuse injury, partly blaming her old coach for not looking after her wellbeing when she was going into her rookie professional races "trashed" or "half cut" and not tapered enough "trying to compete against people that [were] stronger". Reflecting on the impact of the onset of the injury:

I'm very critical of myself and hard but that's cuz I want to do well and I don't want to waste the opportunity I've got and I know that is potentially detrimental to be honest with the pressure I put on myself…I'm trying to relax a bit more as well this year …hopefully doing less I'm going to get to races being actually motivated and like I

want to be there as opposed to oh no not this again which is not, not a good way to go into a race when it's going to hurt you. (Interview 2)

This excerpt highlighted that when performance narratives fail such as through injury or performance decline, Eve experienced narrative wreckage which required her to take a break. The performance narrative and sport ethic she tried to uphold explain how Eve developed pain tolerance capabilities through identity systems normalising extreme suffering as necessary for sporting legitimacy. However, her injury from overtraining illuminated psychological vulnerabilities where she could no longer maintain the extreme standards she expected of herself while transitioning into a rookie professional. During lockdown, Eve's drive to hurt also shifted away, revealing that there needed to be a specific purpose to it and not just for "maintenance and base work" as it was "hard to stay motivated when you have got no races [and] to hurt yourself [for] on a regular basis". Learning from her mistakes, she was only planning to place her energy and drive to hurting into training for races that would boost her professional rating. Reflections in her week 62 journal highlighted the benefits of better coach support with a more structured training program: "A happy, well rested, and de-stressed athlete is one that performs better. Quality over quantity". The fine line of a positively balanced physical and mental wellbeing was finally evident in weeks 61–64 (see Appendix C.7, page 431) where despite still being below norm for general wellbeing, her BRUMS vigor scores were now at the 50 norm and her RESTQ 'being in shape' above norm.

Eve's experience exemplifies how early-career professionals must learn to balance their drive to establish professional identity with the need for sustainable pain management strategies. The correspondence between her BRUMS profiles, training loads, and journal reflections suggested that this learning process involves both psychological and physical adaptation to professional demands.

**Tash: The Late-Career Professional.** Tash's individual pressures and goals related to her self-awareness of entering the "twilight years" as a mainstream Ironman triathlete. This was another example of the performance narrative enacting in how Tash was developing her alternative relational narrative to being professional in a different professional field and context. Although she possessed the drive to push herself as: "Part of a big field and testing herself against the best athletes in the world" those reasons had become less prominent. However, still sponsored, she wanted to prove herself one last time in a mainstream Ironman race before her transition into a new competitive field of XTri. Between race build up weeks 5–15, the data from her event timeline in Figure 4.5 (page 168), timeline of training workload in Figure 4.2 (page 161), and joint display tables 4.2 (page 169) and appendix C.4 (page 424) all highlighted how illness, ongoing injury pain, and general life events were hindering her goal to prove herself: "I bounce between thinking I am doing too much and thinking…train harder as I have an ironman in 6 weeks. It's tough self-coaching…when feeling tired it creates uncertainty makes it harder to tolerate pain" (week 8, journal). This illustrated how fearing a fitness loss from a lack of quality training due to various disruptions in her routine could affect her preparation. This was exacerbated by her conundrum of her being self-coached to maintain the objectivity to plan enough rest and recovery when sick and injured.

Tash's positioning at a late-career stage created a unique relationship with the sport ethic, where her motivation to conform to its demands was waning for mainstream Ironman but strengthening for XTri. This shifting allegiance to different competitive contexts demonstrated how her performance narrative was not monolithic but selectively applied based on other career goals and identity transitions. Her lockdown response of intensifying training as emotional regulation exemplified how deeply internalised the sport ethic had become, where "beasting" herself daily represented not just physical training but a psychological need to maintain athletic identity and sense of control.

During her second interview, Tash reflected on not being able to: "Scratch her final itch" to get final closure in race week 15. However, she was now "happy to walk away" feeling more motivated towards the new transitional race goals in XTri. During her preparation, when all races were cancelled due to the Covid-19 pandemic, the pressure of not needing to hurt was experienced differently by Tash compared to Eve. It highlighted how daily exercise was not just about race preparation, it was: "Absolutely fundamental to my state of mind, to my feeling of wellbeing, to my interaction with other people, to my energy flow, everything" (interview 3). The importance of exercise was more than just being a professional ultra-triathlete, needing to train for a job, it was necessary for her overall wellbeing. Tash's mood and emotions were negatively impacted, as her normal routine was impeded by the lockdown restrictions. The weekly BRUMS mood profiles went from iceberg to submerged during lockdown, and the vigor scores went from 61 in week 29 to below the norm during lockdown (Appendix C.4, page 424). This was supported by her journal entry:

> Tolerance affected by the crazy shit storm that's happening in the world. It's made me want to train more and feel invincible while I am training as it is the only thing that is remotely normal at the moment…I am pleased to find that I train because I love it and even when there are no races or goals on the horizon, I still want to beast myself every day! I wake up wanting to train hard. (Journal, week 32)

Though this showed an intrinsic commitment to her sport, Tash's increased tolerance to intensely train herself was also an emotional response to trying to maintain some control over her situation and her mental wellbeing. Unfortunately, this response came at a price as it eventually negatively tipped the balance of both her mental and physical wellbeing from week 44 (see timeline Figure 4.5, page 168 & joint display appendix C.4, page 424). The intensified training response had influenced her RESTQ scores as in week 29 her TR was 25.33, TS 3.0 whereas by week 44 TR was 19.33 and TS was 5.0. Appendix Table C.4 (page

424) shows the overuse injury developed during this period, and her McGill pain intensity rating went from 6 in week 29 to 15 for week 44.

Additionally, her BRUMS Vigor had decreased from 61 in week 29 to 39, below the 50 norms, by week 44. All this indicated that she was seemingly overtrained because of the emotional and behavioural responses to exercise durations and intensity during lockdown (as evidenced in Appendix Table C.4 (page 424), which shows the progressive deterioration in her stress-recovery balance from weeks 29–44 alongside corresponding increases in McGill pain intensity ratings). This exacerbated the injury that had been building from week 1 to now a potentially serious injury requiring medical attention. Her overall RESTQ General Wellbeing mean values were below the ref value for 64 weeks; similarly, the Injury and Emotional Exhaustion ref values were above the norm. This indicated that physical and mental wellbeing needed readdressing to restore the healthy balance required to compete at the professional level.

**Abbie: The Injured Professional.** Abbie's pressure as a professional was to make a full recovery from an acute shoulder injury and get back to her race schedule as soon as possible. The injury timing coincided with a goal of stepping up her training to the next level to compete against the fast-growing competitive field of new female professional athletes. Throughout the 64 weeks her RESTQ Being in Shape, Personal Accomplishment, and Self Efficacy values were all below the norm mean values indicating the impact the injury was having on her performance goal. For example, post-rehabilitation she assessed her race-form readiness in week 2 but her mood and emotions affected her perceptions and tolerance of pain. In her race reflections afterwards, she wrote: "Not necessarily new - but I wasn't good enough to compete off the back of my injury. We did kind of know this, but you still hope that something will spark. But it was disappointing" (Journal). This performance

disappointment was supported by a BRUMS inverted iceberg mood profile and her TMD of 21 (see Table 4.1, page 163 & Appendix C.1, page 417).

Abbie's journal and interviews highlighted the importance of having the right interdisciplinary support network. For example, in the first injury rehabilitation phase she felt unsupported and frustrated at the lack of performance under her old coach. She partly attributed this to the pressure of "probably having not got that many years left" signalling career stage pressure, compounded by producing the self-realisation that she had become stale in her current professional training routine. Abbie's interview reflections emphasised how being injured had lost her 3-4 years of swimming form and not being "a natural swimmer", this frustrated Abbie as all the hours of hard work and enduring the discomfort and pain to improve her swimming seemed wasted now, as she did not feel like she had another 3-4 years to get it back. This realisation was the catalyst that forced the issue to change her coach in week 17.

Between weeks 20-30, during a second injury period and start of the lockdown, Abbie still felt the pressure to prove herself during what she called a "honeymoon period" with her new coaching team. Her motivation to work hard even in a rehabilitation session meant that her high pain tolerance levels masked signs of a stress fracture developing (see Appendix C.1, page 417). The emotional reaction of having a new injury and the impact of it on her mental wellbeing was evident, especially not being in control again, so it prompted immediate conservative action to maintain some sense of normality:

I hate being injured…focus on what I can. Needed a few days to just get through the pain and injury, but once it got to a relatively manageable level, a plan and structure is good to keep me focused on track and feeling like I'm not losing everything. I have to push for everything myself, even in a professional sport. (Journal, week 26)

Abbie's navigation of injury recovery while maintaining professional identity illustrated the tensions inherent in her performance narrative. Her frustration at losing "3–4 years of swimming form" reflected how athletic accomplishment had become a central identity marker, with time pressure intensifying her drive to return to competition. The "honeymoon period" with her new coach created conditions for positive deviance, where her motivation to prove herself led to overconformity that masked developing injuries. Her pragmatic approach to pain coping surfaced, as the emotions of frustration increased with the pressure of not being able to train at the higher intensity levels again. This was reflected in the RESTQ Total Stress score of 9.33, BRUMS submerged profile with vigor below baseline, and elevated McGill pain rating of 14 (see Appendix Table C.1, page 417, which documents the convergence of these metrics during her rehabilitation period in weeks 25–26). During these frustrations, the importance of having access to an interdisciplinary support network was appreciated to facilitate her recovery back to being race ready: "Biggest thing for me was having the support network around you and speaking to good physios, medical people, strength people who could help on a day-to-day basis and were kind of in your court so to speak". This illustrated how they needed to holistically understand her needs and pressures as a professional athlete and how time was ticking away for the longevity of her career but also to make the most of the time she had left, but mindful of her having high pain tolerance levels in training, rehabilitation, and racing.

In terms of differences in medical support, there were some differences in approach to general population and elite athlete's pain tolerance. For example, Abbie's first surgeon had assigned a one size fits all approach post-first-surgery unaware of Abbie's high pain tolerance levels in comparison to the non-athlete population they would be advising: "In terms of what you can do just gauge on your pain levels if it hurts stop, don't be a hero to push through, but if it doesn't hurt keep going". This is good standard advice and indicates the advice being

dependent on the subjective perceptions and individual thresholds of everyone. Whereas the third consultant in week 30 offered a more athlete-centred individual approach: "It's misaligned…you could leave it for another three months and it might right itself…[but] if you wanna get back into sport quicker…I suggest you have it plated again". Although it may not have been what Abbie wanted to hear, this measured approach seemed to consider the pressure Abbie felt to get back into competing and help her choose the best course of action to achieve this. This approach helped Abbie encompass both proactive health promotion and reactive diagnosis/management of her injuries and illnesses without excessive risk-taking.

Unfortunately, the buildup of frustrations and stress of navigating four health services and differences in medical advice between consultants in four different countries took its toll by weeks 40–43. For example, in week 40 she was navigating the UK medical system during lockdown. This highlighted the importance of having good communication for injury reparation and rehabilitation illustrated in her RESTQ scores of TR 9.33 and TS 6.67 and displaying a slightly inverted iceberg/submerged mood profile (Appendix C.1, page 417).

In summary, the motivation or drive to endure pain in both training and competition was influenced by individual pressures related to career stage and professional identity. These pressures manifested differently: Eve's early-career drive to prove herself led to overtraining and injury; Tash's late-career transitional focus created motivational fluctuations; and Abbie's injury recovery process highlighted how professional identity shaped response to rehabilitation pain. Across all cases, the data demonstrated that balancing healthy physical and mental wellbeing was crucial for managing the required high-intensity training and competition pain.

While Theme 1 demonstrated how professional identity shapes overall approaches to pain, Theme 2 elucidates how these approaches fluctuated across different race contexts and life situations, highlighting the dynamic nature of pain experiences in professional triathlon.

### 4.3.3 Theme 2: 'The rise and fall of pain'

The second theme represented the longitudinal focus of fluctuating perceptions, interpretations, and tolerance levels for pain and discomfort experienced according to their individual timeline situations. The integrated data highlighted temporal patterns in how pain experiences evolved across the 64-week period, demonstrating that pain in professional triathlons is not static but highly dynamic and context-dependent. The fluctuating pain experiences documented longitudinally revealed how athletes' relationships with pain were mediated by their adherence to or resistance of the performance narrative. While all three athletes demonstrated capacity to differentiate their types of pain and discomfort experiences, this evaluative framework was also shaped by cultural expectations about acceptable athlete behaviour. The volitional nature of pain, needing a 'why' to hurt, illustrated how motivation to conform to the sport ethic fluctuated based on competitive context, career stage, and broader life circumstances. These temporal patterns suggested that pain tolerance was not merely a physiological capacity, but a socially constructed practice shaped by professional identity and cultural narratives about what constitutes legitimate athletic suffering.

Analysis of weekly monitoring data, combined with athletes' reflective journals and interviews, showed how these fluctuations occurred within broader patterns of athletic development and competitive demands (see weekly training workload Figure 4.2, page 161; Timeline Figures 4.3, page 162; 4.5, page 167; 4.7, page 173; and Joint Display Tables 4.1, page 163; 4.2, page 169; 4.3, page 174; and Appendices C.1, page 417; C.4, page 424; C.7, page 431). Although the fluctuations of pain experiences were consistent across all athletes, they manifested differently based on career stage, injury status, and competition context.

***Pain Perception Evolution: Individual Case Analyses***

**Abbie: Pain Reference Point Reset.** Examining Abbie's timeline (Figure 4.3, page 162) alongside her integrated data in joint display Table 4.1 (page 163) and Appendix C.1

(page 417) highlighted a pattern of pain experiences predominantly centred around her shoulder injury and recovery process. Figure 4.3 illustrates the temporal sequence of events, while Table 4.1 (page 163) and Appendix C.1 provide detailed quantification of how these experiences manifested in her pain ratings, mood states, and recovery markers during both injury and race-related contexts. The choice of sensory and affective descriptors in appendix C.2 (page 421) showed they were mainly experienced as mild except during the injury and race weeks. During Abbie's first interview she explained how her perceptions of pain and discomfort had been re-booted after her first major injury: "Pre-surgery pain to me is sharp shooting wincing takes your breath away excruciating type feeling...and then anything else is more of like ache achiness dullness...just fatigue general sort of muscle fatigue". The injury-related sensory and affective pain she referred to had been logged in her experience memory and set as a new benchmark to monitor and evaluate against any future pains. Abbie's evolving relationship with pain demonstrated how professional athletes develop increasingly tacit pain evaluation frameworks through experience. Her "re-boot" of pain perceptions following surgery illustrated how significant events can fundamentally alter an athlete's pain reference point, suggesting that pain management expertise develops through an active process of experience and reflection rather than simple exposure to pain.

During physiotherapy and rehabilitation sessions, Abbie's perceptions of injury or bad pain signs versus non-injury just healing but be careful type pain were tested. For example, when the scar tissue was broken up using cross-fibre friction techniques she recounted that she preferred the physio to: "Inflict that kind of…pain" illustrating the different contexts for her pain perceptions and tolerance, separating out the difference between sport-related being voluntary and self-inflicted versus accepting others may need to cause some pain for the good of recovery. Over the 64-weeks, Abbie's perceptions and tolerance levels were mirrored in the QUANT data (Tables 4.1 & Appendix C.1), as the overall McGill results reported mainly

a low NRS and Sum of Intensity for pain except in the specific context of being race-related (weeks 2, 5 & 9), or injury-related, such as a second shoulder surgery in week 19, and during the diagnosis period for a stress fracture (weeks 25–26, 29–30). This showed a similarity between injury and race-related pain or discomfort, although the highest NRS and Sum of intensity was injury related pain in weeks 25 –26 (Table 4.1, page 163 & Appendix C.1, page 417).

In week 32, once the third shoulder surgery stabilised the joint again, a similar re-set occurred in perceptions: "Shoulder surgery and plating of collar bone. So initial aching / soreness around the shoulder, and uncomfortable for sleeping. Towards end of the week not really pain just a little discomfort around the scar and skin" (McGill QUAL entry). This change in perception and tolerance was confirmed by the McGill NRS of 0, and the three sensory descriptors (aching, tender, sharp) recorded at a mild intensity level. In her weekly journal, she wrote: "all low key and being super conscious to not cause any pain, discomfort in the collar bone or do anything to lower the immune system results … Strong pain killers in days 1–2 post surgery. Paracetamol after that". This illustrated Abbie's high tolerance levels for pain but also the self-care she was taking to ensure physical recovery, and her pain interference was low. Towards the end of the longitudinal period, aching became normalised as from weeks 48–64 onwards McGill inventory results reported a perceived NRS of 0/10 and zero adjectives selected (see Appendix C.2, page 422; & Appendix Table C.1, page 417).

Abbie's high pain and discomfort tolerance levels could be influenced by a negative mood, lack of quality sleep, travelling fatigue, socio-cultural influences, and injury status (see Figure 4.3, page 162; Table 4.1, page 163 & Appendix C.1, page 417). For example, during the first injury phase, she realised in comparison to fellow male athletes and people on social media sending support, that she was able to tolerate much more than they could at the same

stage of healing. But this perception could have been due to the plate masking damage and stopping unwanted movement.

Abbie's journal QUANT results showed that her ability to tolerate pain and discomfort was high for most of the 64-weeks (see Tables 4.1, page 163 & Appendix C.1, page 417). The biggest discrepancies between discomfort and pain tolerance levels were in week 1 (training), 32 (third surgery), and 43 (training). For example, in week 1 her journal entry reported: "Interval session- Struggled to hit the top end intervals and manage the discomfort with lack of power I was generating". This resulted in the BRUMS tension scale being on the norm of 50, alongside the journal QUANT results confirming that her emotions/mood influenced her perceptions and control of pain. Examining the SIP results (Figure 4.4, page 167) in week 2, the CAT was above the norm of 50, indicating a low optimistic mindset following her week 2 race performance. The largest disparity between pain and discomfort tolerance and interference was in week 43:

> Wednesday interval session I failed to complete. My head was over this session. Issues with the power meter on the bike and the readings mean I had no idea what I was pushing or if the numbers were right. I tried to add 20W onto the target numbers and then thought I just went too hard or was just over the fact I had no idea what I was achieving and hitting. Lack of clarity still and understanding and getting to see the right specialist about my shoulder as well all finding out what's going on. and just generally hit a wall with life.

This extract illustrated how a combination of factors out of her control had mounted up and taken its toll on her mental wellbeing. As she was relearning to tolerate training related discomfort or pain, it showed how reliant she was on technology to know the numbers to help with her ability to cope for enduring the intervals session. Both extracts also showed how her emotions/mood completely influenced the perception and control of discomfort but

not for pain. The week 43 McGill intensity sum was a mild rating for "aching" and NRS of 0, the QUAL entry reported: "mild / slight aching in collar bone at times" confirming injury was no longer an issue and was more about the emotions of not swimming still.

During interview 3, Abbie reflected on her tolerance levels and the socio-cultural and age-related influence of the triathlon community or industry on her perception of pain and discomfort: "I think endurance sport and triathlon still has that kind of more miles, more volume…There are probably elements of that environment or culture that's probably influenced then how you perceive it yourself". She contemplated the gender stereotyping of male versus female traits which she historically saw "race to competitiveness instincts" as a male trait and being "able to control that feeling or the emotions and the level of discomfort". She reflected that her subconscious bias had now changed as she observed more females coming into the sport who also shared this "male trait". Lastly, now she had her coach, squad, and training environment set up the use of a sport psychologist was mentioned by Abbie. During the injury and non-race phase it was not a priority, but now she saw herself getting back to the race line it was seen as an extra boost to 'give us every chance that when we come back to those races that you can be in the right place' in relation to mindset for coping with high intensity race-related discomfort and pain.

**Tash: Race Pain vs. Injury Pain.** While Abbie's experiences highlighted how injury contexts shaped pain experiences, Tash's data demonstrated how competitive demands influenced pain perception and management. The longitudinal data elucidated how these different contexts required distinct approaches to pain evaluation and coping strategies. Looking at Tash's timeline (Figure 4.5, page 168), both injury and race or training related pain were experienced during the 64-weeks. Observing the McGill pain data in Appendix Figure C.5 page 429 and the integrated results in joint display tables 4.2, page 161 & appendix table C.4, page 424, it was evident that her perceptions of pain varied in intensity

and type according to the context of the race phase, injury diagnosis, and treatment weeks. The McGill weekly pain results showed she selected sensory descriptors across all 64 weeks, whereas the affective descriptors were mainly during the race phase up to week 16. On race day week 15, the McGill QUAL entry supported the McGill pain data sum of intensity increased to 20 with an NRS of 3 (severe) (see Table 4.2 page 169 for details):

> Everything hurts during and after a race like this, especially in the heat. I had left Achilles pain pre-race, but it was fine on race day and only slightly stiff after. I have quite severe right knee pain after, and it has lasted a few days and continues. Not unusual. During the race I had the usual neck and shoulder pain on the bike - like being in a stress position for an extended period of time. Then on the run just very heavy legs and painful feet.

This extract highlighted how Tash monitored and evaluated the intensity of the pain moving around the body during the three disciplines. Drawing upon experience, she understood the cause of the pain as some were expected and normalised. For example, the bike stress position that lasted just for the ride (112 miles), while other pains were more chronic accepted niggles that she had learnt to cope with and was managing them during training and racing. This extract illustrated how professional athletes learned to differentiate between various types and sources of pain while evaluating the implications for their performance in a race.

The interaction between environmental factors and pain experiences was also evident as the extract illustrated how the weather and temperatures could accentuate the perceptions of pain or discomfort. For example, during the run Tash described how her legs felt like: "Two bits of ham hanging rock solid, slapping floor heavy". She found the ability to tolerate this: "Hard to overcome mentally [with] overwhelming heat and exhaustion" and on the day her "mind felt weak" as in the moment she "did not have a strong enough 'why' for

overcoming the pain" nor "care enough about the outcome…I didn't care enough to overcome that all-encompassing discomfort which was screaming at my body to stop". This suggested the drive to hurt needed a point, an objective, a reward for doing so.

During interview 2 Tash had time to reflect on how the pain interference had been hard to manage in race week 15:

I think if you're emotionally tired, mentally tired, mentally fatigued for a race, then it's more difficult to stay focused and to use those positive triggers that you sort of practice during training and things to really make a difference. It's mentally hard, you know, racing is mentally hard…the brain is a muscle. And if it's tired going into a race then you've got less capacity with that muscle than if it's fresh.

This showed how mentally demanding it was to cope with race-related physical effort. But this revealed a juxtaposition when her key point for controlling the pain and discomfort was having the motivation to hurt: "It's quite related to how I'm feeling in self and body... [I]love hurting myself but only if [my] body is strong so if injured not up for hurting self". This extract showed the volitional nature of hurting but on her own terms and conditions of no injuries. This volitional nature was reflected in the weekly journal, where Tash reported that when her routine was disrupted by illness, travelling, poor quality of sleep, and minimal rest and taper prior to racing, it also affected her tolerance levels. She was also negatively influenced by not having someone to ride with her to push her pain barriers, suggesting a psychosocial factor to consider when training.

Tash was able to tolerate pain and discomfort when she interpreted all sensory information as "not sinister pain - all old injuries and pain that I am used to" suggesting she was drawing from past experience and had normalised or desensitised her sensory perceptions. However, when she perceived pain around her hip area this always created a red flag and ignited an emotional response inside, as noted in her journal: "Mood influenced by

injury status - pain tolerance influenced by mood!" until she had her first MRI: "Just knowing there is no bone injury there was a massive improvement in mood and hence pain tolerance for me" (week 25 Journal). Tash was usually well practiced at managing her pain and discomfort using cognitive strategies given to her by a mental strength coach and using self-help medical related strategies or seeking out targeted medical treatment when needed. Post-lockdown, she explained that when you make a choice to hurt it was totally different and more manageable mentally:

> At times I had a very high tolerance, and at other times I had a very low tolerance, and it was purely based on my choice to hurt or not. I pushed really hard on some of my runs and rides at sections of that route that I wanted to (e.g. a big hill) but it was always enjoyable and challenging and was framed very positively in my mind. Just enjoying being out again and feeling the fitness come back so fast. (Journal)

This extract was another example of how Tash's inherent volition to hurt in training was acting and pointed to how cathartic and enjoyable the pain felt as she pushed herself to get fitter. In the Journal, muscle stiffness results (Appendix table C.4, page 424) were recorded as severe during the two MRI diagnoses (week 23–24 and week 44–45) and during the shockwave treatment phase post-second MRI. This meant that the perception of muscle stiffness was perceived higher for injury related contexts than the moderate assigned in a race related situation. In week 45 she wrote in the McGill QUAL entry:

> Right lower back and right hamstring. I have finally gotten to the bottom of all the lower back/glute/hamstring pain I have been getting over the years and today I have had a treatment which I hope will mean it will all settle down for good (spinal injection of cortisoids).

The positive medical result produced an iceberg mood profile and TMD of -9 which indicated how Tash's mood and emotions were linked to pain and gaining information on its

cause to assess the impact on her training and racing. Examining her SIP scores (Figure 4.6, page 172) her CAT T-scores were above the 50 norm in week 2 (62), week 15 (58), and week 29 (58) indicating a low optimistic mindset during the injury pain phases of her timeline especially when she was worried about her previous hip fracture history, but once she started treatment her CAT decreased down below norm in week 43 (47) and week 55 (39) indicating more optimism now she knew the cause and getting the treatment.

During the localised shockwave treatment, Tash struggled to quantify the treatment pain on a scale of 1-10 with a physio, although during a race she was able to assign a jellyfish sting as a 7/10 intensity (Table 4.2, page 169). As a result, the physio used Tash's facial expression responses to assess the pain levels: "I'm so programmed to think that treatments got to hurt that I'm like, gritting my teeth, not telling her and she's like give me a number. And I say six. And she's like right that's an eight" (interview). This showed how cognizant the physiotherapist was of her high pain tolerance and was attentive to how she perceived pain or discomfort. Tash recalled the effects of the treatment being: "Like somebody inside your body and pushing an electric shock on bit that hurts it targets the bit that's broken. Hard to do it by hand so this targets exactly on that point". Then also reflected in being an ultra-endurance athlete: "You're so used to putting your body into a place of pain. But I think your brain must adapt to that and must think, okay, well, we just got to deal with the pain". This was an example of how perceiving and normalising new pain was developed over the longitudinal period and fluctuations of perceptions changed according to new experiences.

**Eve: Career Stage and Pain Learning.** Eve's integrated data demonstrated how career stage influenced pain interpretation and management strategies. The longitudinal data demonstrated how pain management capabilities evolved alongside professional development. Looking at Eve's timeline (Figure 4.7, page 173) and joint display tables 4.3 (page 174) & Appendix table C.7 (page 431), her pain experiences were mainly related to

injury and race-related situations, particularly in the critical period of the first 12 weeks leading to the stress reaction injury diagnosed in week 12. In Appendix figure C.8 (page 437), the most frequently chosen sensory descriptors were mainly at a mild intensity. Examining the SIP coping mechanisms for Eve over the five timepoints (Figure 4.8, page 178), in week 2 both COP and COG were very high above the norm of 50, suggesting that she was focused on training at the training camp and accepting any discomfort or pain as part of the environment. The CAT and AVD were very low, below the norm suggesting at this stage that despite feeling over raced and overtrained as noted in her journal entries, she was still able to perform mentally while experiencing the normal discomfort of training.

In the journal extract for week 2 she was in a training camp: "Discomfort - muscularly from workload and climbing. but generally felt very good. A little discomfort in my left foot /plantar - but nothing experienced stopped training". This was totally different to weeks 1 and 3 with the complete disparity between pain and discomfort interference affecting her performance and tolerance levels. For example, the McGill sum of intensity for week 1 was 9, with an NRS of 3 and in week 3 the sum was 7, with an NRS of 2, two of the highest results over the 64-weeks. This demonstrated how perceptions of pain fluctuated and was contextual to weekly activities.

The journal extracts for both weeks stated: Week 1 (referring to feeling heavy, sluggish, and discomfort in her foot): "Being kind to myself. Made sessions bearable and got me out the door. But not helping me feel like I am gaining fitness - which is making me feel a bit mentally drained and doubtful of next race" illustrating a fear of losing fitness and race form; in week 3: (referring to a high heart rate she was concerned about): "Stopped running / slowed the pace to something more comfortable and what was within my 'perceived' limits - however, this was bounded by confidence and mind limitation". This coping strategy was

indicative of her performance concerns and trying to readdress the balance of both physical and mental wellbeing, substantiated by a very low BRUMS vigor T-score in both weeks.

By week 15, the post-stress reaction diagnosis the COP and COG both plummeted below the norm of 50, suggesting she was not going to ignore the foot pain any longer and needed to concentrate on her mental and physical wellbeing. The increase in CAT and AVD showed her mindset was not positive, potentially due to a disappointing first season ended abruptly by injury. Between weeks 13 –25 of rehab, the McGill pain sum of intensities and NRS fluctuated at low levels and the journal QUANT results (Appendix table C.7, page 431) indicated similarly low levels of interference and high abilities to tolerate. The main coping strategies for any discomfort or pain involved low level training and reframing the focus on recovery, while having a long-term goal of getting back to racing: "Training for fun, so not really pushing limits at the moment or requirement to challenge tolerance limits. Off season is needed and not as scary as it seemed - despite having lost some fitness" (week 14). This illustrated how enforced rest improved her mood and optimistic approach and the pressure she felt to keep training. It also suggested that she was detaching herself from the pressures of being a professional while no races were on the horizon, something which hindsight and experience had given her.

Eve's tolerance levels for pain and discomfort were positively influenced in a social context of seeing significant others and training with friends, face to face or on a virtual platform: "Being happy and in the sun worked for getting through sessions and having a positive attitude. She was also inspired by seeing other professional teams training around her which made doing her hill reps easier and a distraction" (week 27) and in week 29: "training with friends helped me get through my tempo blocks on long ride". Similarly, being motivated outside and in beautiful locations motivated her ability to control pain tolerance: "Being passionate about the challenge is important. The pain barrier moves out when you're

enjoying yourself and 'want' to do it" (week 49) after she had just completed a virtual

mountain run. Her journal reported for tolerance levels: able to tolerate the pain and

discomfort well because it was born doing something I love (mountain running) so it's ok to

hurt for pain - more acute (calf) discomfort - but not doing any damage' which was reflected

in the journal QUANT results for high pain tolerance and low interference to performance.

During the mountain race she dealt with the discomfort from descending and

ascending by breaking down the sections aimed at coping with the physical and

psychological demands. While suffering from post-race discomfort she referred to using:

"Lots of topical ointments, self-massage, stretch, rolling, magnesium, whey, glutamine, stay

hydrated, sleep, rest, back off sessions...I threw everything at it Mon to Weds", suggesting

more self-help coping strategies aimed at the healing of the body. Other self-monitoring

strategies included monitoring her menstrual cycle over the past year and learning to regulate

her nutrition and hydration to ensure sufficient fuelling as they affected her tolerance for

harder or longer training sessions and races. Her steep learning curve for overtraining,

causing her overuse injuries, had shifted her high tolerance levels for pain so that she needed

to listen to her body to not impact on her future professional performance.

In summary, the longitudinal analysis illuminated consistent patterns in how pain

experiences fluctuated across the competitive season for all three athletes, though with

individual variations based on career stage and context. The data demonstrated that pain

perception and tolerance were not fixed traits, but dynamic processes influenced by multiple

factors including race context, injury status, environmental conditions, and psychological

state. All three athletes exhibited high pain tolerance for training and race-related pain yet

showed more cautious approaches to injury pain. This differentiation evolved over time

through experience, with significant pain events (like Abbie's surgery) serving as reference

points that recalibrated future pain evaluation frameworks. The volitional nature of race-

related pain emerged as a key distinction, with motivation to "hurt" requiring clear purpose and contextual meaning.

The two themes presented above, professional identity and fluctuating pain experiences, interact in significant ways. Professional identity shaped how athletes interpreted and responded to pain, while their experiences with different types of pain (training, competition, injury) informed the development of their professional self-concept. For the neo-professional (Eve), developing appropriate frameworks for evaluating and responding to pain was integral to establishing professional identity. For the transitioning professional (Tash), evolving motivations to endure pain reflect shifts in career focus. For the injured professional (Abbie), pain management was central to reclaiming professional identity following setbacks. The longitudinal data revealed how these interactions evolved over time, with notable shifts occurring around key events like injuries, competitive disappointments, and environmental disruptions such as COVID-19. This temporal aspect underscores the dynamic, rather than static, nature of pain in professional ultra-endurance sport.

### 4.4 Discussion

This longitudinal mixed methods study examined how three female professional ultra-triathletes experienced and coped with pain across a competitive season. The study focused on three specific research questions: 1. How do professional female ultra-endurance triathletes perceive, evaluate, tolerate, and cope with their pain experiences over a competitive season; 2. How do biopsychosocial factors influence female ultra-endurance triathlete's pain experiences? 3. Does reflecting and learning from any significant pain events over the season inform future pain experiences and coping in training and competition?

These questions guided the investigation's methodological approach and analytical framework. The comprehensive data collection approach enabled identification of complex

interactions between physical, psychological, and social factors. The cross-case analysis produced two overarching themes: 'It's part of your job - life through the lens of a pro' and 'The rise and fall of pain'. Together, these themes represented how pain experiences fluctuated based on the context of their individual timelines and integrated data revealing how pain experiences were deeply intertwined with professional identity, performance demands, and broader life circumstances. Analysis of these themes highlighted several key findings that directly addressed the questions and demonstrated the complex nature of pain experience in professional ultra-triathlon.

Three key take-home messages that stood out to directly address the research questions. First, regarding how female ultra-triathletes perceive, evaluate, and cope with pain (Research Question 1), their pain experiences have a temporal nature, showing marked variations based on context. Second, addressing how biopsychosocial factors influence pain experiences (Research Question 2), recovery self-regulation was critical for professional performance. Third, concerning how reflection on significant pain events informs future experiences (Research Question 3), professional identity significantly influenced how athletes interpreted, managed, and responded to pain over time.

Addressing the specific temporal dimension of race and training related pains and discomfort experienced, the study drew upon the tenets of the metacognitive attentional framework (Brick et al., 2015) and self-regulation skills of planning, performance, and reviewing (Zimmerman, 2000). Recovery self-regulation was particularly pertinent, as the use of self-monitoring skills was vital to develop awareness of the state of physical capacities, reflected in muscle pain, fatigue, stiffness, as well as cognitive and emotional capacities (Balk & Englert, 2020). It was evident from all athletes that internally monitoring their subjective sensory pain information was common during high intensity training and race scenarios. The pain learning experiences across the 64-weeks filtered into their tacit

metacognitive feelings of difficulty, knowing, familiarity, and confidence to tolerate race-related pain having practiced it in training. This finding supported the assertion that perceived pain arising from exercise involved both physiological and psychological mechanisms (Astokorki & Mauger, 2017), further extended the assertion by documenting integrated evidence from a real-world racing context.

The temporal differentiation between race-related and injury-related pain reflects the broader influence of the sport ethic on pain interpretation. The athletes' heightened tolerance for performance pain—when serving clear competitive purposes—aligned with cultural narratives that valorise suffering for athletic excellence (Hughes & Coakley, 1991; Nixon, 1993). However, the breakdown of this differentiation under certain biopsychosocial conditions revealed the vulnerability created by overconformity. Bursik et al.'s (2025) identification of fluctuating prioritisation of health or success resonates with the current findings, wherein professional ultra-triathletes demonstrated varying risk management strategies based on situational pressures such as race importance, injury severity, and recovery status. When professional identity demands conflicted with physical warning signals, athletes demonstrated the positive deviance pattern identified by Hughes and Coakley (1991), where commitment to sport norms exceeded reasonable boundaries and became self-destructive. The environmental and psychological factors that reduced pain tolerance (heat, fatigue, low motivation) represented moments where more cautious pain evaluations emerged and the performance narrative was less obvious in its influence (Roderick et al., 2000; Theberge, 2008). These findings align with pain science understandings that cognitive and emotional factors modulate pain perception through neurophysiological mechanisms as proposed by gate control and neuromatrix theory and (Melzack, 2001; Melzack & Katz, 2012), while extending this understanding to encompass the social and cultural dimensions of elite sport.

Like other elite athletes, the professional ultra-triathletes were able to monitor their pain and discomfort and know the differences between good and bad pain or discomfort, as a by-product of their training and racing (Bolling et al., 2019). The racing-related joint display tables 4.1-4.3, evidenced the review and evaluation process of athletes' internal self-monitoring of pain or discomfort and their coping. They all had heightened pain tolerance when the pain served a clear performance purpose and tended to perceive effort-related sensations as "discomfort" rather than "pain" (Bolling et al., 2019; Tenenbaum et al., 1999). However, this study extends previous work by showing how this differentiation can break down under certain conditions. It was evident that the ultra-triathletes' lack of pain tolerance was influenced by individualised contextual biopsychosocial factors, such as other's pacing, a lack of motivation, low self-efficacy to meet the intensity demands, a lack of fitness, current injury issues, sleep quality, and overtraining fatigue. Environmental factors such as the heat also negatively affected pain tolerance. During the races, the decisions to reduce work rate (to reduce pain) and disengage from their race goals aligned with similar reports on pain experiences (Kress & Stratler 2007; Mauger, 2014). In professional ultra-triathlon, individuals who are willing to tolerate more pain demonstrate superior endurance performances than those who are not (Astokorki & Mauger 2016). The findings highlighted the psychological determinants and environmental factors that could affect the willingness and ability of the three ultra-triathletes to manage their pain in a race.

As there was no TENS machine to block out the perceived pain (Astokorki & Mauger, 2017), the athletes' needed to employ their usual cognitive strategies such as triggers, mantras, disruption techniques, and self-talk, like those detailed by Brick et al. (2015). However, as shown by the ultra-triathletes' race BRUMS profiles and journal entries, directly influenced their neurophysiological pain processing systems, demonstrating the integrated nature of cognitive and physiological pain mechanisms proposed by the gate

control theory. These athletes were usually able to block out the pain signals using their cognitive strategies, but the highlighted biopsychosocial and environmental factors affected their ability to ignore the pain. These temporal and context-dependent findings advanced knowledge away from the laboratory and put them into context of a real naturalistic setting, demonstrating how the athletes self-monitored and reviewed their pain during training and competition.

Intertwining with the second key finding, recovery self-regulation was highlighted as critical for professional performance. The ability to effectively regulate recovery, as recommended by Balk and Englert (2020), was crucial for maintaining performance while managing pain. The athletes were constantly balancing the professional pressure to 'hurt' as part of their job, with the need for adequate recovery throughout the competitive season. However, the athletes' struggles with recovery self-regulation can be juxtaposed through the lens of the sport ethic, which inherently devalues rest and recovery as potential indicators of insufficient commitment (Bursik et al., 2025; Coker-Cranney et al., 2018; McGee et al., 2024). Eve's fear of 'losing fitness' if she rested, Tash's intensified training during lockdown, and Abbie's 'honeymoon period' overtraining all demonstrated how cultural narratives about dedication and work ethic undermined self-regulatory capacity.

This finding extends Bursik et al.'s (2025) theme of externalising risks and refraining from proactivity by documenting the longitudinal process through which overconformity develops—not as sudden events but as gradual erosion of self-protective boundaries under the influence of professional identity pressures. The athletes' responses to injury-related pain revealed a different temporal pattern. Whereas all three athletes demonstrated high pain tolerance for training and competition, injury pain produced more cautious responses and lower tolerance levels. This finding builds on Bolling et al.'s (2019) work on pain interpretation in athletes by demonstrating how past injury experiences reshaped future pain

evaluation. This required self-monitoring (Zimmerman, 2000) their sensory information to distinguish niggles and old injuries against race-related pain, to prevent overuse injuries developing. The findings highlighted that these self-regulation skills were not always evident across the 64 weeks.

The current findings aligned with other studies, demonstrating that training through pain and with increased training load caused a stress fracture (Johnston et al., 2020). For the neo-professional ultra-triathlete, the overtraining injury led to a positive cathartic effect, resonating with the self-reflection phase in cyclical nature of self-regulation (Zimmerman, 2000). While following the recommended treatment of rest and reduced workload and allowing time to recover fully after her injury (Meussen et al., 2013), the ultra-triathlete reflected on ignoring the build of pain and signs of overtraining. She realised the pressure of her first year had influenced this due to a fear of losing fitness if she rested. The development of stress fractures and overuse injuries across all three athletes represented the ultimate consequence of this overconformity, demonstrating how the sport ethic's emphasis on refusing limits transformed into clinically significant injury (Johnston et al., 2020; Mayer et al., 2018; Schnell et al., 2014).

The third key finding followed that the professional status and identity significantly influenced how these ultra-triathletes interpreted, managed, and responded to pain. This identity-based approach to pain management created both opportunities and challenges as while it could enhance performance through increased pain tolerance, it also masked serious issues when athletes prioritised professional demands over physical wellbeing. The three athletes demonstrated varying relationships with their personal performance narrative (Carless & Douglas, 2013). For example, Eve initially adapting to her new rookie professional status, and in the wake of twilight years looming, Tash was transitioning between competitive contexts, and Abbie was struggling to reclaim professional identity post-

injury. These different positions on the performance narrative continuum shaped their willingness to engage in positive deviance through overconformity to training demands. This identity-based approach to pain management created both opportunities and challenges: while it enhanced performance through increased pain tolerance in competitive contexts, it also masked serious issues when athletes prioritised professional demands over physical wellbeing (Coakley, 2015; Hughes & Coakley, 1991). The finding that all three athletes eventually sustained overuse injuries from overconformity demonstrates the inherent risks within the sport ethic framework, where cultural narratives celebrating dedication and toughness can transform adaptive coping strategies into maladaptive overtraining patterns (Bursik et al., 2024).

The longitudinal data revealed how athletes demonstrated varying proficiency in the three critical self-regulatory skills proposed by Balk and Englert (2020) i.e. self-monitoring, as evidenced in the journal entries; regulation of cognition and emotion, as seen in the BRUMS profiles and adaptive coping strategies; and self-control, manifested in decisions about training modification and recovery periods. Athletes who maintained a balance between professional identity and physical wellbeing demonstrated more effective implementation skills, especially during enforced or critical recovery for injury. Optimal recovery self-regulation, therefore, requires not only physiological awareness but also critical reflection on how professional identity and cultural narratives influence pain interpretation dimension in addition to psychological approaches to self-regulation (Balk & Englert, 2020).

The recovery self-regulation challenges observed across all three athletes may have been compounded by sleep quality issues, which remain underexamined in female ultra-endurance populations. Researchers using general athlete samples indicate that poor sleep quality (prevalence 50-83%) is associated with 2.4 times higher odds of depression, anxiety, and somatoform disorders (Drew et al., 2018). Athletes diagnosed with overtraining

syndrome demonstrate decreased sleep quality, with disrupted sleep identified as a likely trigger rather than merely a symptom (Meussen et al., 2013). The temporal patterns observed in athletes' pain tolerance, particularly the reduced capacity to manage race-related discomfort under conditions of fatigue, may reflect underlying sleep deprivation effects. While the current study used the RESTQ-36 to monitor recovery-stress balance, future longitudinal research with female endurance athletes could incorporate more sleep-specific screening tools such as the Athlete Sleep Screening Questionnaire (Bender et al., 2018) to determine whether sleep quality influences the relationship between training load, mood disturbance, and pain interpretation observed here.

The findings can be systematically mapped to Karos et al.'s (2024) four-level biopsychosocial framework, demonstrating how pain experiences operate across multiple social strata. At the intra-individual level, athletes' pain perceptions fluctuated based on mood, sleep quality, and recovery status, as evidenced by BRUMS and RESTQ data. At the interpersonal level, coach-athlete relationships, training partners, and medical practitioners directly influenced pain tolerance and management strategies. Abbie's contrasting experiences with different surgeons illustrated how interpersonal dynamics shaped pain evaluation and treatment decisions. At the positional level, career stage created differential pressures: Eve's neo-professional status intensified pressure to prove herself through pain tolerance, contrasted with Tash's late-career positioning and accumulated professional experience enabled more strategic pain management and selective engagement with competitive demands. This aligned with Bursik et al.'s (2025) finding that risk management strategies exist on a spectrum from passive (externalising risks) to active (calculated risk-taking), with career stage significantly influencing athletes' position on this spectrum.

The relationship between injury, performance, and mental wellbeing observed in this study operationalises biopsychosocial interconnections through prospective temporal

tracking. Elite sport brings specific stressors that potentially increase the likelihood of both injury and illness, including mental health disorders, and injury can potentially unmask or trigger mental health disorders (Wiese-Bjornstal et al., 2010). The stress experienced by all three athletes such as training demands, competitive pressures, COVID-19 disruptions, and career transition challenges, consistently demonstrated temporal relationships with both injury risk and rehabilitation capacity. Meta-analytic evidence, derived predominantly from cross-sectional designs, indicates that high stress response and history of negative stressors have the strongest associations with injury rates (Ivarsson et al., 2017), corroborating the current findings where Eve's neo-professional transition stress, Tash's lockdown intensification, and Abbie's return-to-performance pressures all preceded overuse injury development in the longitudinal data.

Certain psychological and sociocultural factors raised as potential injury risk factors in research with female team sport athletes (Pensgaard et al., 2017) were evident across the three cases. Perceived negative life event stress from teammates and coaches has been associated with increased risk of acute and overuse injuries, and negative perceived recovery has been linked with both injury types ((Pensgaard et al., 2017). These patterns were clearly demonstrated in the temporal data revealing injury development during periods of high stress and inadequate recovery. The current findings extend this evidence to female ultra-endurance athletes, demonstrating how stress-injury relationships manifest within individual athletes over extended time periods rather than across athlete samples at single time points.

Finally, at the ideological level, the sport ethic (Coakley, 2015; Hughes & Coakley, 1991; Nixon, 1993) and performance narrative (Carless & Douglas, 2013) operated as cultural forces that transcended individual athletes, shaping what counted as legitimate versus illegitimate pain responses within professional triathlon culture. The development of overuse injuries across all three athletes—despite different personalities, support systems, and coping

strategies—suggests that ideological-level factors exerted powerful influence on pain experiences, often overriding individual-level awareness and interpersonal-level support (Bursik et al., 2025; Thiel et al., 2015). This multi-level analysis reveals that effective pain management interventions must address not only individual coping skills and interpersonal relationships but also the positional pressures and ideological narratives that create systemic vulnerability to positive deviance.

This study advances theoretical understanding of pain in elite sport by using a biopsychosocial lens. The integration of sociocultural frameworks—specifically the sport ethic and performance narrative—strengthens the biopsychosocial understanding of pain in this study by illuminating the social and cultural forces that shape pain experiences. While the biological dimension captures physiological pain mechanisms and the psychological dimension addresses individual cognitive and emotional responses, the social dimension as conceptualised here extends beyond interpersonal relationships to encompass cultural narratives, professional identity construction, and systemic organisational factors. The sport ethic represents a set of collectively held norms that create social pressures for conformity, with overconformity leading to positive deviance that becomes normalised within professional sporting contexts (Hughes & Coakley, 1991). This sociological lens explains why all three athletes—despite different personalities, career stages, and support systems— demonstrated similar patterns of overtraining and injury development. Their pain experiences were not merely individual psychological responses but were fundamentally shaped by their socialisation into professional triathlon culture and their positioning within performance-oriented narratives (Carless & Douglas, 2013). Understanding pain through this integrated biopsychosocial framework reveals that effective interventions must address not only individual coping strategies and physiological monitoring but also the cultural systems that reward dangerous levels of conformity to professional expectations.

The current study's longitudinal mixed-methods approach makes a distinctive methodological contribution to understanding pain management in elite sport. The effective mixed method use of monitoring the athletes via logbooks, diaries, interviews, and inventory questionnaires was in line with other studies as it highlighted injury and overtraining (Dijkstra et al., 2014; Hainline et al., 2017; Johnston et al., 2016; Rabitte, 2019; Saw, 2015). This approach extends Bursik et al. (2025) approach of using biographical mapping interviews to capture athletes' retrospective constructions of risk (pain) management across athlete careers. In future, coaches and practitioners could utilise a journalling approach for athletes to self-monitor their mood, rest, and reflect on their training and competition pain experiences to initiate the recovery process. Professional ultra-triathletes would benefit from understanding how different factors influence their pain experiences and learning to distinguish between productive and potentially harmful pain responses. This education should include specific strategies for monitoring and managing pain across different contexts, particularly during periods of high training load or competition stress.

Medical practitioners should consider how athletes' professional identity influences their pain interpretation and reporting. The study showed how high pain tolerance can mask serious issues, as demonstrated by the development of stress reactions and overuse injuries across all three athletes. Medical staff should develop assessment protocols that distinguish between different types of pain while considering how an athlete's professional identity might influence their pain reporting. Regular monitoring of both subjective pain experiences and objective markers of physical stress could help identify emerging issues before they become serious injuries (Hainline et al., 2017).

An effective coach-athlete relationship was an important influence in helping to maintain balanced physical and mental wellbeing. For coaches, understanding the temporal nature of pain tolerance and motivation is crucial for program design. The findings

demonstrate how athletes' capacity and willingness to endure training-related pain fluctuated

based on multiple factors, including recovery status, competitive goals, and career stage

(Bolling et al., 2019). This suggests the need for more subjective and holistic approaches to

training periodisation that consider not just physical readiness but also psychological

willingness to engage with high-intensity training. Like Sanders and Winter (2016), the

findings provided a contextualised and subjective perspective from athletes feeling the

pressures of transitioning to the high intensity level of professional level and corroborated the

conceptual relevance of a practical model of change (Samuel & Tenenbaum, 2011).

Similarly, in the athletic career transition model (Stambulova, 2003, 2009, 2016) the

process is described as the need to cope with a set of transition demands using relevant

coping strategies that take internal (person-related) and external (environment-related)

resources and barriers into consideration. The transition outcomes and relevant pathways are

shown to be dependent on the effectiveness of coping. Unfortunately for Eve, her journal

identified crisis-transition symptoms such as a decrease in self-esteem, lasting emotional

discomfort, increased sensitivity to mistakes and failures (e.g., DNF), and an increased

number of internal barriers (e.g., low self-efficacy for coping with pain at the new

professional level), and disorientation in decision-making and behaviour for overtraining and

injury (Stambulova, 2000). These symptoms were less evident for Tash and Abbie despite all

experiencing injuries which were impacting on their continuing professional careers. Having

career transition support is key not only from a coach, but also from a sport psychologist who

understands the combined psychological and physical wellbeing support required for

managing the performance and pain demands at professional level (Schinke et al., 2018).

Although the sport psychologist role was not emphasised by the triathletes, it would be

pertinent for practitioners to support the new professional athletes and those in twilight years,

to not only teach self-regulatory skills to manage the pressures to hurt in training and racing but also assist with the stressors of transitioning in and out of the sport.

The three professional ultra-triathletes in this study were subject to the pre-2023 ranking system before it was updated. This was when there was no differentiation between races whereas now the tier of a race (awarded based on race prestige and athlete remuneration) sets its base points level, the strength of field is considered, and an athlete's finishing position and time relative to other finishers are also factored in. This outputs a final score that rewards athletes consistently finishing in a strong position and time at the most competitive races with the biggest prize purses. Meanwhile, lower-tier races offer the opportunity for athletes to build their race resume and move up into the highest echelons of professional triathlon racing, such as the PTO Tour. As neo-professional, this new system would have benefited Eve navigating the pressure of age group career transition, as there are now over 470 professional female athletes (https://protriathletes.org/pto-world-ranking-system).

Part of the pressures of a professional achieving their performance goals is to manage the factors that may affect their perceptions of race-related pain or discomfort, and subsequent ability to tolerate it during a race. These factors can be related to the type of race route terrain (e.g., swim: sea versus lake; bike/run: hilly versus flat), climate (e.g. humid), weather (e.g., heat or cold). Other factors to consider are costs for travel and accommodation, acclimatization and time zone differences to ensure sufficient rest and recovery, and taper before a race. The findings concur with how multiple stressors, added to the high intensity physical training and racing they regularly needed to endure (Meussen et al., 2013). Taking all of this into account, it suggests why there was pressure to perform and to stay race ready by Abbie, Tash and Eve despite being injured and in a Covid Lockdown.

This would be a key point for coaches to consider if a similar situation arose for their athletes. As part of their job, sometimes overstepping the fine line into periods of overtraining and training and competing with normalised discomfort and pain also exposed them to the risk of picking up overuse injuries which was in line with other research findings (Johnston et al., 2020). Given the influence of physiological information on runner self-efficacy and subsequent running performance, coaches and practitioners should ensure that runners' training schedules allow for adequate rest and recovery, to reduce the occurrence of pain or soreness (Shipherd et al., 2021). Finally, it is important to understand the pain experienced from a psychosocial perspective as well as the expected biological so that the coach, medical-based practitioners, and sport psychologist can get a better sense of the pressures leading to the diagnosis and treatment of overuse injuries, as supported by Hainline et al. (2017). For example, understanding their drive to hurt during training and racing, the factors that influence their tolerance levels and perceptions of pain, and how they can gain the trust of the athlete to communicate their anxieties about evaluating the seriousness of new pains or discomforts. It is important to monitor what is going on in an athlete's life, because stressful life events can alter performance and ability to tolerate pain (Otter et al., 2016).

**4.4.1 Methodological Considerations and Future Research**

Within the broader framework of professional athletic life, the integration of multiple data sources enhanced understanding of pain experiences through methodological triangulation. The combination of using each method concurrently triangulated and complimented the overall timeline of results, for example, during a race or injury diagnosis week, the fluctuating rest and recovery, coping mechanisms, mood and pain entries matched the QUAL diary entries. This combination proved especially valuable in identifying relationships between perceived pain, psychological state, and recovery status that single-method approaches might have missed.

The MPQ-SF QUAL dimension proved effective in detailing the locations, intensities and types of pain or state felt at the time and provide the opportunity to discuss if it was more discomfort than pain, given their perceptual differences for race- and injury-related pain and discomfort. The MPQ-SF did not allow for monitoring the tolerance levels and the contextual BPS factors influencing them at the time and longitudinally, however, this was the advantage of having a weekly diary to contextualise the background information to support the inventory data. The findings from the BRUMS, and RESTQ-36 extend the findings of previous studies monitoring for overtraining, fatigue, mood changes and underperformance (Barnett et al., 2012; Coutts et al., 2007; Nicolas et al., 2011; Parsons-Smith et al., 2017, 2022) as the findings were effective at monitoring the dimensions of balancing the longitudinal physical and mental wellbeing over a longer period, identifying weeks of overtraining and mood responses to events and how these could influence their pain tolerance levels and perceptions, fluctuating according to the timeline of event incidences.

Particularly effective was the combination of quantitative monitoring tools with qualitative insights. The Sport Inventory for Pain (SIP) results, when contextualised by interview data and journals, revealed how coping strategies evolved in response to different challenges across the season. This extends previous research (Anderson & Hanarhan, 2008; Polenske et al., 2022; Salma & Meyers, 2019) by showing the dynamic nature of pain coping mechanisms in response to varying competitive demands. This illustrated new insight and understanding of the dynamic cyclical nature of self-regulatory processes of learning from adversity and growth by reflecting on effective support and identifying other psychosocial and environmental factors that needed to be planned for to optimise their professional career and performance (Tamminen et al., 2013; Zimmerman, 2001).

A potential limitation of the current study is that while the COVID-19 pandemic provided unexpected insights into pain experiences without competitive contexts, it also

introduced unusual circumstances that may have influenced the typical patterns of professional athletic life. Conducting the same study post-lockdown with more race related pain experiences and coping would prove beneficial. A second limitation is the lack of triangulation of using objective physiological biomarkers. The addition would have objectively confirmed the athletes feeling over-raced and overtrained. However, this creates a research opportunity for a multidisciplinary team to track and monitor athletes. For example, social support and social interaction are reported to stimulate the production of oxytocin, which is related to a reduction in blood pressure and cortisol levels (Uvnas-Moberg & Petersson, 2005). Future researchers could combine biopsychosocial monitoring of cortisol and creatine kinase to triangulate MPQ-SF, RESTQ and BRUMS data, alongside qualitative data, to check on signs of overtraining and overuse injuries and effects of social support systems building up during the race period. This could evidence for intervention strategies to educate the athletes and coaches to plan a more strategic race plan for maximum performance output and recovery.

Beyond methodological considerations, the findings highlight the importance of examining gender as a salient factor shaping pain experiences in professional ultra-endurance sport. The experiences of these three female professional ultra-triathletes raise important questions about how gender intersects with the sport ethic and performance narrative. All three athletes referenced gender stereotypes in relation to pain tolerance, with Abbie noting her perception that "race to competitiveness instincts" and "controlling emotions and discomfort" were historically viewed as "male traits," though she observed more females entering the sport demonstrating these characteristics. McGee et al.'s (2024) recent research demonstrated how conformity to the sport ethic can facilitate psychological maltreatment, with female athletes potentially experiencing unique pressures within male-dominated sporting cultures. The prevalence of overuse injuries across all three participants may reflect

not only general sport ethic pressures but also these gendered expectations to prove toughness and commitment. Wellard's (2016) conceptualisation of gendered performances in sport provides a useful framework for examining how female ultra-endurance athletes navigate embodied experiences of pain whilst managing gender expectations in male-dominated ultra-endurance culture.

Future researchers should build upon the present study's longitudinal design whilst addressing its limitations and explicitly examining how gender ideologies intersect with the sport ethic to shape pain experiences. Whilst the current study provided prospective weekly monitoring over 64 weeks, combining this approach with Bursik et al.'s (2025) biographical mapping method could capture both real-time fluctuations in pain management and athletes' evolving retrospective interpretations of these experiences. Comparative studies across different sports and cultural contexts could identify broader patterns in risk perception and management, as risk management strategies are shaped by sport-specific norms, changing organisational expectations, and gendered sporting cultures (Bursik et al., 2025). Additionally, Sanders and Winter's (2016) finding that career transitions in triathlon create periods of heightened vulnerability suggests that future longitudinal research should focus on these critical junctures, examining how female athletes navigate embodied pain experiences during periods of transition.

### 4.4.2 Implication for Applied Practitioners

As discussed in the third key finding, the findings from this study have important implications for the various stakeholders involved in professional ultra-triathlon. For athletes, developing context-specific pain evaluation frameworks would be beneficial. Professional ultra-triathletes should be encouraged to develop self-monitoring practices that help them distinguish between productive training pain and potentially harmful injury pain. This distinction became evident across all three case studies, where the athletes demonstrated

different approaches to race-related versus injury-related pain. Athletes would also benefit from implementing structured recovery protocols that effectively balance performance needs with physical wellbeing, particularly during periods of high training load or competitive stress. Additionally, athletes should consider how their career stage influences reasonable expectations around pain tolerance and performance, as evidenced by the different approaches demonstrated by Eve (neo-professional), Tash (late-career), and Abbie (returning from injury).

Coaches play a crucial role in helping athletes navigate pain experiences effectively. An effective coach-athlete relationship was an important influence in helping to maintain balanced physical and mental wellbeing. The findings indicated that coaches should implement more holistic approaches to training periodisation that consider not only physical readiness but also psychological willingness to engage with discomfort. As seen particularly in Eve's case, understanding how career stage influences pain tolerance should inform coaching expectations and feedback. Professional ultra-triathletes would therefore benefit from athlete-centred education programmes that foster proactive physical health risk management, promote an internal locus of control, resilience, and awareness of long-term health risks. This education should include specific strategies for monitoring and managing pain across different contexts, particularly during periods of high training load or competition stress and should explicitly address how professional identity and cultural narratives influence pain interpretation (Balk & Englert, 2020; Bursik et al., 2025; McGee et al., 2024). For coaches, understanding the temporal nature of pain tolerance and motivation is crucial for programme design, as athletes' capacity and willingness to endure training-related pain fluctuated based on multiple factors, including recovery status, competitive goals, and career stage (Bolling et al., 2019; Mayer & Thiel, 2018; Sanders & Winter, 2016). Promoting sleep hygiene practices and creating training environments that validate recovery are an essential

component of performance rather than a sign of weakness is also important, as all three athletes struggled at times with the balance between pushing through discomfort and allowing adequate recovery. Coaches should facilitate open communication about pain without reinforcing potentially harmful cultural narratives about "pushing through" at all costs—a pattern that led to overuse injuries in all three cases. Furthermore, monitoring athletes' life stressors is essential as external factors consistently influenced pain tolerance and perception.

Medical practitioners should consider how athletes' professional identity influences their pain interpretation and reporting. The study showed how high pain tolerance can mask serious issues, as demonstrated by the development of stress reactions and overuse injuries across all three athletes. Bursik et al. (2025) identified how athletes frequently relinquish control under medical uncertainty, relying heavily on formal diagnoses to legitimise symptoms before acting. This finding was corroborated in the current study, where athletes often ignored pain until medical professionals validated their concerns. Medical staff should therefore develop assessment protocols that distinguish between different types of pain while considering how an athlete's professional identity and career stage might influence their pain reporting (Paul et al., 2022; Sanders & Winter, 2016; Waddington & Roderick, 2002). Regular monitoring of both pain experiences and markers of physical stress could help identify emerging issues before they become serious injuries (Hainline et al., 2017).

Sport psychologists can provide valuable support for ultra-triathletes by teaching specific cognitive strategies for managing different types of pain, like the mantras/self-talk and distraction techniques that Tash reported using during races. The findings indicate that helping athletes balance professional identity with physical wellbeing is crucial, especially during career transitions when pain management approaches may need adjustment. Sport psychologists should address the emotional components of injury-related pain, particularly for athletes whose identity is strongly tied to performance, as seen in all three cases but most

prominently with Abbie. Developing tailored coping strategies for the unique psychological demands of ultra-endurance events would also be valuable, as environmental factors like heat and terrain significantly modified pain experiences during competition.

Beyond individual-level interventions, the findings highlight the need for broader cultural change within professional ultra-triathlon. The sport ethic's emphasis on sacrifice, pain tolerance, and refusing limits creates systemic conditions that normalise and reward overconformity (Hughes & Coakley, 1991). Addressing positive deviance requires not only educating athletes about self-regulation but also transforming the cultural narratives that valorise dangerous levels of commitment. Coaches, media, sponsors, and governing bodies all play roles in either reinforcing or challenging these narratives. The Professional Triathletes Organisation's updated ranking system, which now differentiates between race tiers, represents one structural change that might reduce pressure for neo-professionals like Eve to overtrain in pursuit of every competitive opportunity. However, more fundamental shifts are needed in how professional communities define and celebrate athletic excellence. Creating space for alternative narratives, such as the 'relational' and 'discovery' narratives identified by Douglas and Carless (2006, 2015), could provide athletes with identity resources that don't depend solely on performance outcomes. This might involve highlighting athletes who maintain multidimensional identities, celebrating sustainable training practices alongside competitive achievements, and critically examining language that equates pain tolerance with moral virtue. Such cultural interventions could complement individual-level support by reducing the social pressures that drive positive deviance in the first place. Implementing these multidisciplinary recommendations would create a more comprehensive approach to pain management in professional ultra-triathlon, potentially reducing injury risk and enhancing both performance and wellbeing throughout the athletic career.

### 4.4.3 Conclusion

This longitudinal mixed method multiple case study design contributes to advancing understanding of pain experiences in professional female ultra-triathletes in several important ways. First, it demonstrates how pain experiences in professional ultra-triathlons operate within a complex self-regulatory framework where athletes must constantly balance performance demands against recovery needs. Second, it reveals how professional identity fundamentally shapes the willingness to experience pain, suggesting that motivation to endure discomfort is influenced by career goals and competitive contexts. Third, it shows how various biopsychosocial and environmental factors dynamically interact to affect both pain perception and management strategies. These contributions have specific relevance as professional ultra-triathlon continues to evolve with new competitive structures, extreme environments, and increasing performance demands. The study suggests that supporting athlete wellbeing while maintaining high performance standards requires a holistic understanding of how pain experiences fluctuate across training cycles and competitive periods. This pain understanding becomes especially crucial during career transitions and periods of highly competitive stress, when established pain management strategies may need adjustment. By illuminating how female professional ultra-triathletes perceive, evaluate, and cope with pain over time, this study provides a foundation for developing more targeted monitoring approaches and support systems that can enhance both performance and wellbeing across the athletic career span.

**Chapter Five: A mixed methods multiple case study for examining pain and coping experiences during ultra-endurance events.**

This chapter advances the previous findings in chapters 3 and 4, employing a similar mixed-method multiple case study approach to monitor the real-time race pain and coping experiences during different ultra-endurance events.

## 5.1 Introduction

Pain perception and coping in ultra-endurance sports represent a complex phenomenon that challenges our understanding of human performance limits. While the physiological demands of ultra-endurance events have been well-documented, the intricate interplay between biological, psychological, and social factors in pain experience remains poorly understood, particularly among female athletes (Knechtle & Nikolaidis, 2018). The emergence of ultra-endurance sports as a context for studying pain management is particularly relevant given the increasing participation of female athletes in these events and their notable achievements in previously male-dominated competitions (Fox-Harding & Kendall, 2024; Tiller et al., 2021; Waldvogel et al., 2019). Such extraordinary achievements highlight the crucial role of psychological factors and active self-regulatory strategies to succeed in challenging ultra-endurance events.

Ultra-endurance sports take place in a variety of settings, terrains, and locations which results in variations that not only affect the biomechanical, physiological, nutritional, sociological, and psychological (Best et al., 2018; Judelson et al, 2015b; McNarry et al., 2020, 2021; Raja et al., 2020; Roebuck et al., 2018; Schutz et al., 2012; Thorpe & Clark, 2020) demands of the chosen event, but also the strategies employed by athletes and their support crews. Due to the prolonged duration of ultra-endurance, decrements in most or all body systems are to be expected (Berger et al., 2020). Therefore, a biopsychosocial lens offers a comprehensive framework for examining how ultra-athletes interpret influencing

factors for their perceptions of pain and evaluations of pain, and subsequent coping strategies employed to deal with extreme demands while maintaining performance.

Performing well under pressure, having confidence and control over environmental and strategic challenges, and coping in an effective manner can make an important difference for completing a race, especially in ultra-endurance-based events (McCormick et al., 2018b). Ultra-endurance pain can be limiting to performance and a reason for withdrawal (Antoni-Philippe et al., 2016), with the potential for adverse effects on function and social and psychological wellbeing (IASP, 2020). Hence, understanding how pain is perceived, and its severity is relevant to the interdisciplinary practitioners who support these athletes, given the extreme risks and demands of events (Bolling et al., 2019; Hainline et al., 2017; Hoffman & Fogard, 2011; Jull, 2017).

Understanding pain in ultra-endurance contexts requires recognising its subjective and multidimensional nature (Jull, 2017; Melzack, 2001; Raja et al., 2020). The theoretical foundation for understanding ultra-endurance pain experience emerges from the integration of three complementary frameworks: the Neuromatrix Theory of pain (Melzack, 2001), Self-Regulation Theory (Zimmerman, 2000), and Metacognitive Framework for attentional focus and cognitive control (Brick et al., 2015). The Neuromatrix Theory (Melzack, 2001) identifies three interconnected dimensions of pain experience: sensory-discriminative (the physical sensation), affective-motivational (emotional responses), and cognitive-evaluative (interpretation and meaning-making based on experience, cultural learning, attention and expectation). The use of the biopsychosocial domains as a theoretical lens has provided valuable understanding athletic pain, where the voluntary nature of exposure to physical stress creates unique contexts for pain interpretation (Tesarz et al., 2012).

This approach aligns with Self-Regulation Theory (Bandura, 1991; Zimmerman, 2000) for understanding the factors (including environmental) that influence how athletes

manage pain across different temporal phases: forethought (pre-event planning), performance (during-event monitoring), and self-reflection (post-event review). In ultra-endurance contexts, these phases align with critical episodes of heat or challenging terrain where athletes must actively regulate their responses to mounting physical stress and fatigue (Joslin et al., 2013). Understanding this integration is crucial, and Self-Regulation Theory enables examination of how athletes monitor and adjust their responses to pain across different temporal phases of an ultra-event (Cleary & Zimmerman, 2001; Zimmerman, 2000).

Research on metacognition, which is defined as an individual's insight into, and control over their own mental processes (Flavell, 1979), in endurance sports has demonstrated that athletes with greater metacognitive proficiency display enhanced self-regulatory behaviours (Brick et al., 2015). These metacognitive processes manifest differently across each phase of self-regulation, influencing how athletes prepare for, monitor, and learn from pain experiences. The ability to effectively monitor and control attention during endurance activities has been linked to both performance outcomes and pain management (Brick et al., 2016). To deal with discomfort, fatigue, and pain associated with endurance performance under pressure, athletes tend to direct attention to both internal (e.g., bodily) sensations and external (e.g., environmental) stimuli (Brick et al., 2015). Indeed, diverting attention and ignoring pain strategies are associated with the ability to function physically and psychologically regards coping with pain (Jensen & Karoly, 1991). This cognitive approach creates research interest into how the athletes process and act on these decisions.

More recently, researchers have sought to adopt an alternative perspective to investigate cognition by collecting data during task performance (McGreary et al., 2025). This alternative approach is termed the think-aloud method and was proposed by Ericsson and Simon (1993), whereby two distinct levels of verbalisation were identified: Level one

requires vocalisation of task relevant thoughts only. Level two requires participants to recode visual stimuli, not regularly verbalised, prior to providing verbalisation on the task. These two levels are a result of conscious thought processing in short-term memory (STM) during the execution of a task, providing concurrent verbalisation during or immediately after a task has been completed. Verbalisations occur most often in environments where participants are provided with undirected probes to think-aloud naturally during the execution of a task (Ericsson & Simon, 1980).

Recent empirical studies have shown how adaptive this method is for effectively collecting and reporting athletes' cognitive thought processes during running (Johnson et al., 2023; Samson et al., 2017) and cycling (Whitehead et al., 2018), revealing references to pain and discomfort during their activity with examples of active self-regulatory strategies to cope. However, the participants used were not ultra-endurance athletes and the pain experience was not the research focus. The real-time data collection method offered by the think-aloud method, combined with pre- and post-event assessments, could provide insight into how female ultra-athletes perceive and manage pain across an event's duration. Performers with greater metacognitive proficiency possess self-regulatory behaviours that allow planning, monitoring and control of experience (Oliver et al., 2021). Multiple case study design enables both depth and breadth in understanding pain experiences across different ultra-endurance disciplines, while pre- and post-event interviews provide crucial context for understanding how pain experiences inform athlete development (Yin, 2018).

A research opportunity exists for examining female ultra-athletes' pain experiences across different ultra-endurance sports using a mixed method approach. Previous quantitative studies using standardised instruments like the Sports Inventory for Pain (SIP: Meyers et al., 1992) and McGill Pain questionnaire (MPQ-SF: Melzack, 1987) have provided valuable insights into coping styles (SIP: ultra running; Cushman et al., 2018; Parkins et al., 2024) and

attentional mechanisms in pain perception (MPQ-SF: Boat & Taylor, 2017). However, these standardised instruments, while methodologically reliable, fail to capture the dynamic and subjective nature of pain experiences as they unfold during actual events. Even when researchers have collected pain data in naturalistic settings, such as in Schutz et al.'s (2012) study, the focus has primarily been on pain testing with limited female participation, rather than understanding the complete pain experience. This gap between controlled measurement and real-world experience points to the need for a more comprehensive methodological approach that can capture both the measurable aspects of pain and its lived experience in ultra-endurance events.

From a qualitative research approach there has been an insightful focus on types of pain relating to exercise or injury perceived differently such as appraised during their ultra-endurance activities but these studies usually centred on retrospective recall dimension emphasising the pleasure from pain, the development of embodied bodily knowing, and how endurance communities create a space for sharing pain and suffering stories (Addison et al., 1998; Allen-Collinson, 2013, Allen-Collinson & Jackman, 2022; Antonini-Philippe et al., 2016; Atkinson et al., 2008; Hanold, 2010; Lev, 2019, 2021; McNarry et al., 2021). This interpretive sense making cannot adequately capture the dynamic temporal nature of pain perception and coping strategies as they evolve throughout an ultra-event (Neale, 2025), especially based on comparisons of retrospective experiences and then re-evaluated in the context to their physical environment, weather, or health condition.

From a mixed method and case study design, studies of female ultra-athletes using adaptive coping strategies of humour, having high self-efficacy (running: Johnson et al., 2016; swimming: Judelson et al., 2015a) have offered valuable but limited insights into pain experience and management strategies, often missing the real-time cognitive processes that influence performance. Previous mixed methods studies that used an effective temporal

design (i.e., before, during, and after) to gather data from an ultra-run event, highlighted during-event stressors (i.e., cramping and injuries, gastrointestinal problems, and thoughts about quitting) and coping strategies such as making small goals, engaging in a mental/physical battle, monitoring pace, nutrition, hydration, and social support (Holt et al., 2014). However, the post-event interviews were conducted nine months after the event. Taken together, all the studies, while valuable in advancing understanding of ultra-athletes' pain experiences, highlight significant methodological challenges in pain research within ultra-endurance sports.

This study addresses several critical gaps in understanding female ultra-athletes' pain experiences. First, it examines pain perception and coping across multiple ultra-endurance sports to ascertain similarities and differences between real-time experiences. Second, it captures pain experiences in naturalistic settings, providing ecological validity often missing from laboratory-based studies. Finally, it integrates pre-, during-, and post-event data to examine how pain experiences and coping strategies evolve throughout an ultra-endurance event. Understanding how female ultra-athletes perceive and manage pain has significant implications for multiple stakeholders in ultra-endurance sports. For practitioners, including coaches, medical staff, and sport psychologists, this knowledge can inform more effective support strategies that account for the unique challenges female athletes face during ultra-events (Hainline et al., 2017). For athletes, insights into successful pain coping strategies across different ultra-disciplines could enhance preparation and performance (Bolling et al., 2019; McNarry et al., 2020, 2021). From a theoretical perspective, examining pain experiences through a biopsychosocial lens in naturalistic settings contributes to understanding of how psychological and social factors influence physiological pain responses during extreme endurance challenges (Hainline et al., 2017; Jull, 2017; Zimmerman, 2000).

This study employed a mixed method multiple case study design to address three interrelated research questions corresponding to the stages of Self-Regulation Theory (Zimmerman, 2000):

1. How do female ultra-athletes' pre-event pain expectations and planned coping strategies influence their approach to ultra-endurance challenges? (Forethought Phase)

2. What cognitive processes do female ultra-athletes employ to interpret and respond to pain during ultra-events, and how do these processes interact with environmental and biopsychosocial factors in naturalistic settings? (Performance Phase)

3. How does post-event reflection on pain experiences contribute to the development of future pain coping strategies and performance enhancement? (Self-Reflection Phase)

By addressing these questions through a comprehensive methodological approach, this study contributes to both theoretical understanding and practical applications in ultra-endurance sports. The integration of real-time data collection with pre- and post-event analysis provides unprecedented insight into how female ultra-athletes successfully manage extreme physical challenges, informing future research and practice in this rapidly evolving field.

## 5.2 Method

### 5.2.1 Design and Approach

Building on the metatheoretical framework established in Chapter 1, this study was conducted from a pragmatic worldview, pluralist ontology, and interpretative epistemology, viewing the research opportunity as a holistic, interactive process of merging qualitative and quantitative approaches (Cresswell & Cresswell, 2020; Onwuegbuzie & Leech, 2005). This philosophical stance is particularly appropriate for pain research in ultra-endurance contexts, especially when adopting a biopsychosocial lens, where the complexity of the phenomenon necessitates multiple perspectives across multiple domains. The researcher's pragmatic

worldview underpinned the mixed method approach, allowing insight to inform understanding (Braun & Clarke, 2022; Cresswell & Cresswell, 2020; Onwuegbuzie & Leech, 2005; Yin, 2018). The pluralist ontology supported the integration of different data types, recognising that both quantitative measures (SIP scores and McGill pain data) and qualitative experiences (interviews and think-aloud protocol) contribute to holistic knowledge about pain experiences (Clarke et al., 2016; Smith & Monforte, 2020). The interpretative epistemology and biopsychosocial lens guided the reflexive thematic analysis which valued reflexivity and researcher subjectivity (Braun & Clarke, 2022). This approach acknowledged that meanings are constructed through interpretation rather than simply discovered. The researcher positionality reflects a commitment to understanding complex phenomena through a biopsychosocial lens, which acknowledges the interplay of biological, psychological, and social dimensions in human experience

To address the research questions, a mixed method multiple-case study design approach was employed that collected both qualitative and quantitative data to examine pain experiences, coping, and reflections before, during, and after five ultra-events (see Figure 5.1, page 231). The use of capital and lower-case letters and + sign for QUAL + quant denoted the relative importance for their sequential data collection, analysis, and interpretation stages (Cresswell & Cresswell, 2020). Mixed methods were selected specifically to enable examination of the multidimensional nature of pain as conceptualised in Neuromatrix Theory (Melzack, 2001), capturing both the measurable aspects (quantitative) and experiential dimensions (qualitative).

Multiple case study design was deemed appropriate because it allows for both in-depth analysis of individual cases and cross-case comparison, enabling identification of both idiographic experiences and shared patterns (Yin, 2018). This approach was particularly suited for addressing the research questions examining how athletes' pain experiences

exhibited in their real-world context across different temporal phases, aligning with Zimmerman's (2000) self-regulation framework of forethought, performance, and reflection.

Figure 5.1

*A Timeline of Data Collection Procedures*
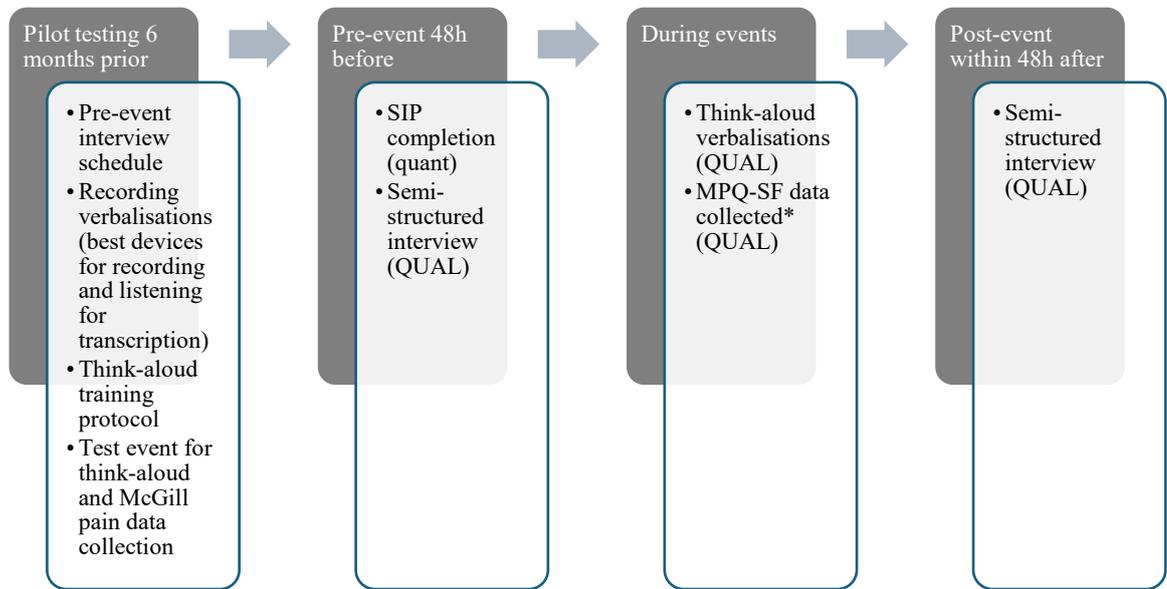


*Note:* *MPQ-SF pain data was only collected during the amateur events: 8848 Everest bike challenge and A100 trail running.

## 5.2.2 Participants

Following institutional ethical approval SMU_ETHICS_2020-21_313 (see Appendix A.3, page 383), five female ultra-endurance athletes aged between 36 and 52 years old (M = 44; SD = 6.26) were recruited for the study (see Table 5.1 for participant demographics, p.232). The sample size of five participants was determined based on methodological considerations for multiple case study designs, where Yin (2018) suggests that 4–6 cases remain manageable for in-depth analysis while providing sufficient breadth for cross-case comparison. This sample size allowed for thorough examination of each participant's experience across multiple time points (pre-event, during event, post-event), generating rich longitudinal data while remaining feasible for detailed cross-case analysis.

The purposive sampling strategy targeted female ultra-endurance athletes across different sports disciplines to examine how pain experiences might vary across ultra-endurance contexts. This sampling approach was selected to address the identified research gap regarding female athletes' specific pain experiences and the limited cross-disciplinary research in ultra-endurance contexts (Hall & Rhodes, 2024; Hainline et al., 2017). Four participants were recruited by contacting organisers of different ultra-events who posted a recruitment message on their event forum website. The fifth participant was recruited via email from a previous study.

All participants were emailed a participant information form once they met the following inclusion criteria: female, English-speaking, currently active and competing in ultra-endurance events throughout the year, experienced with at least five ultra-races completed in their current sport. Ultra-endurance sport events were defined as having a duration longer than 6 hours to complete (Zaryski & Smith, 2005). All participants were based in Europe, provided written consent for participation in the study, and were allocated pseudonyms. Written authorisation and consent were given by each event organiser prior to conducting the study during their events.

**Table 5.1**

*Participant Demographics and Sport-Event Information*

| Participant | Nationality | Ultra Sport | Event | Country | Level of competition |
|---|---|---|---|---|---|
| Trudy | British | Triathlon | XTri Norseman | Norway | Elite professional |
| Judith | British | Running | GB Qualifier 24-h track | UK | Elite (non-professional) |
| Leah | British | Trail Running | Autumn 100 (miles) | UK | Recreational |
| Zoe | British | Cycling | Everest 8848 Challenge | France | Recreational |

| Nathalie | French | Cycling | Everest 8848 Challenge | France | Recreational |
| --- | --- | --- | --- | --- | --- |

The deliberate inclusion of both elite and recreational athletes, as well as participants from different ultra-endurance disciplines, was intended to provide diverse perspectives on pain experiences while enabling cross-case comparison. This approach addresses the methodological gap identified by Hainline et al. (2017) regarding the limited research examining pain across different ultra-endurance disciplines.

**5.2.2 Materials**

***Think-aloud Recording Device.***

To capture participants' verbalisations during the ultra-events, a wrist-worn recording device resembling a Fitbit watch was used (see Appendix B.3.3. for pilot test details, pages 408-416). This device was selected for its minimal interference with performance, water resistance, extended battery life (8+ hours), and unobtrusive design. These features were essential for ensuring data collection throughout extended ultra-events without compromising ecological validity, a key consideration identified in the literature review regarding the limitations of laboratory-based studies.

***McGill Pain Questionnaire Short Form (MPQ-SF).***

To capture event-related pain experience data, an adapted A4 sized laminated version of the McGill Pain Questionnaire Short Form (MPQ-SF; Melzack, 1987) was devised (see Appendix B.3.3.C page 397 and for pilot example and final version, page 414-415). The purpose was to monitor the athletes' temporal sensory and affective dimensions of pain such as type, location, frequency, and intensity during their events. The MPQ-SF was selected for its established reliability and validity as a multidimensional pain assessment tool that captures both sensory and affective dimensions of pain, aligning with the Neuromatrix Theory's

conceptualisation of pain as having sensory-discriminative, motivational-affective, and cognitive-evaluative dimensions (Melzack, 2001).

The instrument has previously been used for similar endurance-related studies to measure perceptions of pain (Boat et al., 2021; Burckhardt & Jones, 2003; Strand et al., 2008; Wright et al., 2001), demonstrating its applicability to sport contexts. The adapted form was a double-sided A4-size laminated card with a blank front and back body diagram on one side, and enlarged 15 representative words (11 sensory and 4 affective) and an intensity ranking of 0 (none) to 3 (severe) on the other, according to the statement 'How bad is your present pain intensity right now?' The lamination and size adaptations were specifically designed for field use in various weather conditions and to enable quick completion during ultra-events.

### *Sport Inventory for Pain (SIP).*

The Sport Inventory for Pain (SIP; Meyers et al., 1992) was used to identify participants' capacity to cope with pain contextualised around previous ultra-endurance pain experiences. The SIP was selected because it provides a multidimensional assessment of pain coping specifically validated for sport contexts, allowing examination of different psychological approaches to pain management. The online inventory (see Appendix B.2.6 for details, page 400) was emailed as a secure link to each participant prior to their pre-event interview. The introductory instruction read: 'Below is a list of statements that describe the way athletes often feel about discomfort/pain and its influence on performance. Please read each statement carefully and select the box to the right that best describes your feelings at this time. There are no right or wrong answers.' The participants were asked to contextualise their answers in relation to experiencing race-induced muscular pain; exertional pain; or injury-related pain while taking part in their ultra-endurance sport.

The SIP is a 25-item self-report instrument that measures five pain-coping traits relevant to sport and clinical environments. Each item was scored using a 5-point Likert

format ranging from strongly agree (1) to strongly disagree (5). Trait measures were direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD). The total coping response composite score (TCR = COP + COG - CAT) serves as an overall indicator of the ability to perform mentally while experiencing physical discomfort. The SIP was recently used to quantify the coping skills of female ultra-runners (Parkins et al., 2024), demonstrating its applicability to female ultra-endurance populations. The aim was to discuss their pre-event results as part of the post-event interview reflections to observe any changes after the event experience. These quantitative results were then integrated with the qualitative data to provide a more comprehensive understanding of pain coping strategies.

### 5.2.3 Pilot Procedures and Preparation for Field Work Data Collection

To ensure the design and aims of the study would be as effective as possible, a series of pilot procedures were conducted (Holt et al., 2014; Yin, 2018). This thorough approach to pilot testing was implemented to address methodological challenges identified in previous field-based research, particularly regarding the reliability of data collection in naturalistic settings.

*Interview.*

A pilot semi-structured career-based interview (Swan et al., 2015) was conducted with an ultra-endurance female runner to prepare the final pre-event interview schedule. This pilot interview allowed testing of question phrasing, sequence, and potential probes, ensuring that the final protocol effectively addressed the research questions while remaining appropriate for participants. Final changes were made to the order of the questions and prompts (see Appendix B.3.1, page 405). The post-event schedule was not piloted as each event-focused interview (Jackman et al., 2022) required tailoring to the individual's specific event experience, pre-event SIP data, and real-time think-aloud data.

**Think-aloud Preparation.**

Pilot testing was conducted to test and confirm all aspects of equipment, think-aloud training, and use of equipment in the field in preparation for the events. This process aligned with similar pilot testing procedures for field research (Holt et al., 2014) and addressed methodological challenges regarding the implementation of think-aloud protocols in naturalistic settings. A full account of the pilot protocol testing is available in Appendix B.3.3.A-E, pages 408-416. The pilot testing included testing equipment functionality in various weather conditions and during different movement patterns; refining the think-aloud training protocol to ensure participants understood expectations; developing strategies for managing data collection across extended durations; and testing the integration of think-aloud with other data collection methods. This comprehensive pilot testing was essential for ensuring methodological rigour in field conditions, addressing a significant gap in current research methodology which often fails to adequately prepare for the challenges of data collection during actual ultra-events (Holt et al., 2014; McGreary et al., 2024).

**5.2.4 Data Collection**

The data collection process followed a temporal design examining pre-event, during-event, and post-event phases, aligned with Zimmerman's (2000) self-regulation framework of forethought, performance, and reflection.

***Pre-event.***

**Quantitative.** The Sport Inventory for Pain was completed via a secure online link which was emailed to participants 48 hours prior to their event. This timing was selected to capture participants' baseline pain coping tendencies while minimising interference with final event preparation.

**Qualitative.** All pre-event semi-structured interviews were conducted within 48 hours before each of their events. This timing ensured their preparation and travel to the event were

not affected while allowing them to reflect on their preparation. Four interviews were completed online, and one was in person. The purpose of these career-based interviews was to explore their perceptions of pain, previous events and training related pain experiences, current pain coping strategies, and reflections on their preparations and expectations for their upcoming event (Swann et al., 2015).

Example questions included: (Warm-up/rapport building) How are you feeling going into this event? (Exploring how reviewed previous experiences and coping) How have any past experiences influenced your ability to tolerate pain? (Exploring planning for the event) Thinking back on your preparations for this event, what sort of pain do you expect to feel during this event and where? (Exploring planning for coping with pain) For this event, how do you anticipate coping with any expected or unexpected pain during this event?

This interview phase aligned with the forethought phase of Self-Regulation Theory (Zimmerman, 2000), examining both task analysis (how athletes analysed the upcoming event and potential pain challenges) and self-motivation beliefs (confidence in their ability to manage anticipated pain).

**Think-Aloud Training.** To prepare participants for verbalising their thoughts during events, they completed a structured training session one week before their respective events. The training focused on teaching participants to share their immediate thoughts and experiences without analysing or explaining them, allowing natural verbalisation while maintaining performance focus. This approach follows Ericsson and Simon's (1993) guidance on minimising reactivity and ensuring valid protocol data.

Participants practiced this skill through four progressive tasks based on Ericsson and Kirk's (2001) protocols, completing activities like word puzzles and basic calculations while cycling or running to simulate event conditions (see Appendix B.3 for detailed training protocols and materials, page 408-416). The gradual progression from simple to more

complex tasks helped participants become comfortable with the verbalisation process while engaged in physical activity.

Training was conducted online for four participants and in person for the fifth participant, with all exercises performed on either a static bike or while running to mirror event conditions. All participants confirmed their understanding of the protocol and demonstrated proficiency with the wrist recording device before their events.

**During the Event**

**Qualitative.** All participants were instructed to "think-aloud any thoughts that come into your mind about pain, or anything else that you choose to talk about. Do not explain any of these thoughts." This approach, following Level 2 verbalisation guidelines from Ericsson and Simon (1993), was selected to capture spontaneous cognitive processes with minimal interference to performance. The instruction allowed insight into the dynamic interactions between the participant and their changing environment for contextual richness (Eccles & Arsal, 2017). For example, the Everest challenge cyclists were given a small, laminated card attached to their handlebars to remind them to think-aloud while in the Pyrenees. During the 8848 Everest Challenge and A100 trail-run events, the recording devices were swapped at convenient checkpoint times to download the data and allow recharging given the length of the events. During the 24-hour track event, the support crew on the trackside ensured the recorder was fully charged and changed throughout the period.

The McGill SF-MPQ laminated card was used during the A100 ultra-trail and 8848 cycling events to record how their pain experiences changed or evolved over the course of the event. The brief conversations were also recorded via a Dictaphone as a backup to the recording devices. The researcher chose not to use the McGill pain check cards during the two elite events (Norseman triathlon bike leg and 24-hour track GB qualifier) as it was

deemed a possible performance interference for Trudy and Judith. They instead gave periodical updates about their pain experiences through their think-aloud verbalisations.

### *Post-event.*

**Qualitative.** A second semi-structured interview was completed with each participant within 48 hours post-event. This timing of each event-focused interview allowed participants enough time to recover, travel back where relevant, and acquire temporal and contextual information about their latest pain experiences and reflections on pain coping strategies (Jackman et al., 2022; Smith & Sparkes, 2016). The interview schedules were constructed within a flexible framework and tailored for exploring participants' experiences during the specific event just completed rather than general career patterns (see B3.2, page 406). This included think-aloud verbalisations during their event, the results of their SIP, and their McGill pain check feedback. The choice and order of questions was guided by the athlete responses (Cachia & Millward, 2011).

This post-event phase aligned with the self-reflection phase of Zimmerman's (2000) Self-Regulation Theory, examining how athletes evaluated their performance and pain management strategies, their causal attributions regarding successful or unsuccessful pain coping, and how these reflections might inform future approaches.

### 5.2.5 Data Analysis

### *Qualitative.*

As stated earlier, in keeping with the researcher's pragmatic worldview and interpretivist paradigm, reflexive thematic analysis with abductive reasoning was chosen to analyse the qualitative data due to its commitment to continual reflective and thoughtful engagement with the data and analytic process (Braun & Clarke, 2022). This analytical approach was selected specifically for its flexibility in addressing complex phenomena across multiple cases using a biopsychosocial lens, while maintaining sensitivity to individual

experiences. This aligned with the research aims of identifying both idiographic experiences and shared patterns.

The two interviews per participant and their think-aloud verbalisations were transcribed verbatim, which also included the verbalisations from the McGill pain checkpoint data for Leah, Zoe, and Nathalie. The pre-event interviews lasted between 22 –97 minutes (M = 49.2, SD = 32.4); post-event interviews lasted between 47 –122 minutes (M = 77, SD = 29.66); and think-aloud verbalisations lasted between 283 –1016 minutes (M = 674.4, SD = 355.73).

The pre-, post-event, and think-aloud verbalisations for each case study were analysed sequentially to maintain the temporal pre, during, and post event experience and reflective learning taking place. This was achieved through ongoing familiarisation with the data set; an open-ended organic coding process; initial theme generation of tentative prototype themes from codes; developing and reviewing and testing those prototype themes against the data and developing them as needed; defining and naming final themes (Braun & Clarke, 2022; Terry & Hayfield, 2022).

The analysis was grounded in the data and conducted using the six stages of reflexive thematic analysis with a combination of semantic and latent coding focus for theme development, first by hand, followed by using NVivo 12 to help collate and organise the researcher's initial codes and theme developments across the temporal dimensions (Braun & Clarke, 2022). The analysis incorporated an integrated approach that acknowledged both the empirical data and the theoretical frameworks inevitably informing the research. Initial coding remained close to the participants' experiences and expressions, allowing patterns and themes to develop organically from the data. As analysis progressed, these patterns were considered in relation to established frameworks of self-regulation (Zimmerman, 2000) and metacognitive processes (Brick et al., 2015), enriching understanding while maintaining

grounding in participants' experiences. This produced an overall temporal perspective of pre, during, and post-event phases (Braun & Clarke, 2022).

***Quantitative.***

The pre-event SIP raw score results were made more meaningful by converting them to T-Scores, to be compared to a norm of 50 (Meyers et al., 1992). This standardisation allowed for meaningful comparison across participants and with normative data.

***Mixed Methods Integration***

The integration of qualitative and quantitative data followed a systematic process designed to maximise insight while maintaining methodological integrity (Cresswell & Cresswell, 2020; Yin, 2018). This integrative approach addressed the identified methodological gap regarding limited integration of quantitative and qualitative approaches in pain research.

**Figure 5.2**

*A Representation of the Mixed Method [Core Convergent] Multiple Case Study Design*
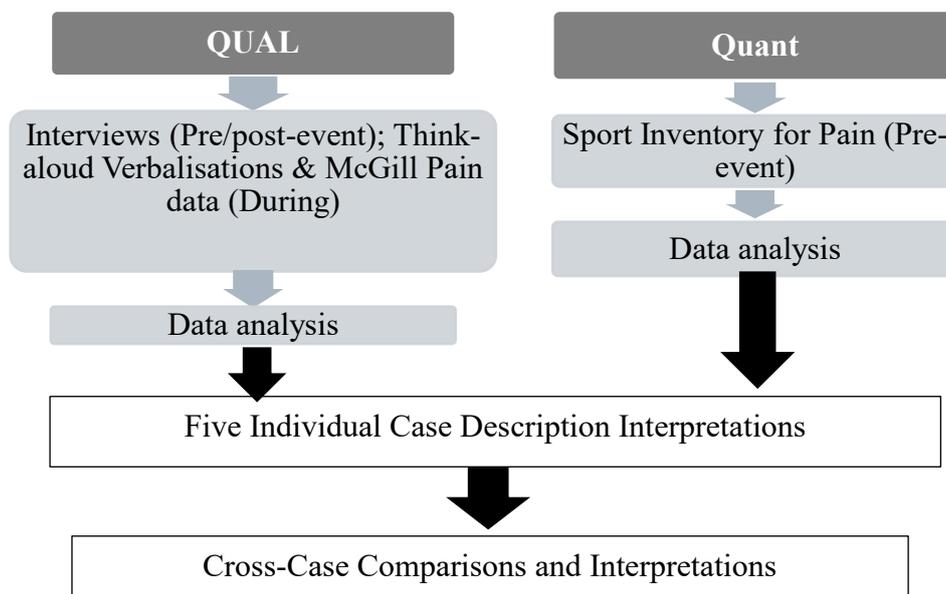


The integration process occurred at multiple levels to ensure comprehensive understanding of the pain experiences across different ultra-endurance contexts:

**Within-case integration.** For each participant, think-aloud data was temporally mapped against pain measures (MPQ-SF laminated card) to understand and compare real-time experiences aligned with measured indicators (Plano Clark et al., 2015). This mapping was complemented by analysis of convergence between SIP scores and verbalised coping strategies, allowing examination of how measured coping capacities manifested in actual event conditions.

**Temporal integration.** Data from each phase (pre-, during-, and post-event) was integrated to examine how pain expectations, real-time experiences, and reflective learning interacted across the temporal dimension. This approach aligned with Zimmerman's (2000) cyclical model of self-regulation. For example, this integration allowed examination of how athletes' pre-event training for anticipated pain (such as cold-water immersion) compared with their real-time experiences during events, and how these experiences were subsequently incorporated into their reflective learning for future competitions.

**Cross-case integration.** Patterns identified within individual cases were systematically compared across participants to identify convergence and divergence of both shared experiences and contextual variations. This integration enabled examination of how different sporting contexts, experience levels, and individual characteristics influenced pain experiences. Joint display tables were designed to highlight key examples of pain experiences and coping examples (see Appendices: D.1 - Trudy, page 439; D.2 – Judith, page 441; D.3 – Leah, page 443; D.4 – Zoe, page 446; D.5 Nathalie, page 448). The joint display tables were structured to present data from each temporal phase alongside quantitative SIP scores for each participant. Each table organised data by key themes including 'Perception of pain,' 'Coping strategies,' and 'Influences' (both positive and negative) to facilitate pattern identification within and across cases. These displays enabled direct comparison between

quantitative pain coping scores and qualitative expressions of pain experience, highlighting convergence and divergence across different data sources.

The cross-case analysis systematically examined both temporal patterns and contextual variations across participants (Yin, 2018). This approach enabled identification of relationships between quantitative pain measures and qualitative experiences while maintaining sensitivity to individual contexts. By employing both variable-oriented and case-oriented analytical strategies, the study captured both general patterns in pain experiences and context-specific variations across different ultra-endurance disciplines (Yin, 2018). This dual analytical approach aligned with the study's pragmatic philosophical stance (Cresswell & Cresswell, 2020), to elucidate both broad patterns and individual experiences from the data.

## 5.2.6 Methodological Rigour

The study's methodological integrity was established through multiple strategies aligned with the JARS-Qual, Quant, and Mixed Methods Standards (Levitt et al., 2018). These strategies ensured fidelity to the subject matter while achieving research goals across both qualitative and quantitative components (Fetters & Freshwater, 2015). The data collection process incorporated comprehensive pilot testing of all instruments and protocols, with particular attention paid to the adaptation and validation of field-use instruments such as the MPQ-SF. This thorough preparation enhanced the reliability of data collection procedures across all cases, supported by regular equipment and protocol checks during events to maintain consistency (Yin, 2018). The thoroughness of pilot testing and review of all data collection methods and protocols confirmed their practicality and reliability in race conditions (Holt et al., 2014). This was particularly important for adapted instruments like the MPQ-SF, where field testing helped ensure the tool's effectiveness in the specific context of ultra-endurance events. This comprehensive approach to methodological rigour addressed the unique challenges of collecting naturalistic data in ultra-endurance field contexts.

Specifically, the pilot testing of the think-aloud protocol during actual physical activity ensured minimal reactivity during data collection, while the systematic adaptation of the MPQ-SF for field use maintained ecological authenticity and validity while accommodating the practical constraints of ultra-endurance events (Burke 2016; Smith, 2018). These methodological adaptations represent a significant contribution to field-based research methods in sport psychology, demonstrating how rigorous data collection can be achieved in challenging naturalistic settings.

To ensure analytical rigour, a systematic audit trail was maintained using NVivo to help collate notes and mapping throughout the research process, documenting analytical decisions and theoretical developments (Braun & Clarke, 2022). This documentation process supported the equal consideration of all evidence during analysis, as recommended by Yin (2018). Data immersion with ongoing reflection was maintained throughout the analytical process, supported by regular consultation with the supervisory team who acted as 'critical friends' (Smith & McGannon, 2018). These critical friends challenged the researcher's beliefs and constructions of knowledge, enhancing the reflexivity essential for rigorous empirical research.

The researcher's reflexivity was systematically addressed through ongoing examination of personal, methodological, and theoretical assumptions, following Finlay's (2002) research reflexivity model. The abductive analytical approach (Morgan, 2007) required reflexive attention to the recursive engagement between data and theory, ensuring that theoretical frameworks enhanced rather than constrained interpretation of participants' experiences. The researcher's professional background as a sports massage therapist was actively engaged with as an analytic resource throughout the research process (Braun & Clarke, 2022). This insider positioning provided valuable embodied knowledge of pain experiences, injury management, and the physical demands of endurance sport, which

facilitated rapport-building with participants and enabled nuanced understanding of their pain descriptions and coping strategies.

However, this professional expertise also required careful reflexive attention to how therapeutic frameworks and clinical perspectives might shape data collection and interpretation. Regular reflexive journaling throughout the research process documented how the researcher's positioning influenced analytical choices and interpretive possibilities, aligning with McGannon and Smith's (2015) approach to reflexivity in sport research. For instance, journal entries explored moments during interviews where participants' pain descriptions resonated with or diverged from clinical understandings, and how the researcher navigated the boundary between therapeutic and research roles when participants sought advice about pain management. Supervisory consultations provided crucial opportunities to make explicit how professional knowledge informed interpretation, to consider alternative readings of the data, and to examine taken-for-granted assumptions about pain and endurance emerging from therapeutic practice. These discussions focused not on minimising the researcher's influence, but on ensuring conscious, deliberative engagement with how professional positioning shaped the knowledge produced (Braun & Clarke, 2022).

This comprehensive approach to methodological rigour addressed the unique challenges of collecting valid and reliable data in ultra-endurance contexts. Specifically, the pilot testing of the think-aloud protocol during actual physical activity ensured minimal reactivity during data collection, while the systematic adaptation of the MPQ-SF for field use, maintained measurement validity while accommodating the practical constraints of ultra-endurance events. These methodological adaptations represent a significant contribution to field-based research methods in sport psychology, demonstrating how rigorous data collection can be achieved in challenging naturalistic settings. In summary, by combining systematic documentation, reflexive practice, and thorough testing, the research approach

supported the trustworthiness and credibility of the findings (Yin, 2018). The researcher's professional positioning was engaged with as a situated strength rather than a limitation to be overcome, contributing to the depth and nuance of understanding achieved.

### 5.2.7 Ethical Considerations in Field-Based Data Collection

Data collection during competitive ultra-endurance events raised distinctive ethical considerations regarding participant safety and the potential for research procedures to compromise performance or wellbeing (Palmer, 2016). The study design was piloted to check for any risks to be managed (Vijayan, 2010). Ultra-endurance competitors experiencing extreme fatigue, pain, or physiological stress represent temporarily vulnerable research participants, even when they possess high athletic competence and decision-making capacity under normal conditions (Palmer, 2016).

The think-aloud protocol presented a unique ethical challenge: ensuring the protocol did not interfere with critical performance decisions while not exploiting athletes during moments of physical vulnerability. To address these concerns, extensive pre-event training familiarised participants with natural verbalisation patterns that minimised cognitive interference while maintaining methodological rigour. Participants were explicitly instructed that performance and wellbeing took absolute priority over research verbalisation, with clear protocols to pause or cease verbal reporting without explanation. This ensured that no harm would come to the participants during their events (BPS, 2021; Vijayan, 2010).

Protocol training also incorporated discussion of how research participation might heighten participants' metacognitive awareness of pain processing during competition (Harriss et al., 2019). Participants were informed that systematic verbalisation might alter their natural pain processing patterns, and that they could withdraw from think-aloud components while continuing other aspects of the research if they felt the protocol compromised their performance or experience. These safeguards reflect Palmer's (2016)

principle that researchers must attend to ethics in practice—the real-time ethical decisions

required during fieldwork—rather than relying solely on pre-planned procedural approvals.

Field notes documented the researcher's ongoing ethical decision-making during each data

collection event, creating an audit trail of situational judgments about participant wellbeing

and data collection continuation. Rigorous research procedures and design incorporated

participant protection, informed consent, while maintaining high methodological standards

(BPS, 2021; Palmer, 2016; Vijayan, 2010).

## 5.3 Results and Discussion

This study employed a combined results and discussion format to convey the

complex, dynamic self-regulatory processes of pain regulation across temporal phases.

Immediate contextualisation through cross-case analysis maintained the essential holistic

understanding of case study methodology (Jackman et al., 2017; Yin, 2018). Additionally,

this approach was preferred as integration and concurrent presentation of findings and

interpretation were central to understanding the complex temporal phenomena (Bazeley,

2024). This approach aligned with previous studies following a similar format (Jackson et al.,

2017; Jackson et al., 2024b) for enhanced methodological rigour and practical utility for

applied audiences.

This section presents the cross-case analysis of the five individual case studies using a

temporal (i.e., pre-, during-, and post-event) synopsis and interweaving approach under two

overarching themes: Learning from Pain Experience and Importance of Support. The

integrated SIP results are displayed in Figure 5.3, page 249, and the case study Joint display

tables (see Appendices: D.1 - Trudy, page 439; D.2 – Judith, page 441; D.3 – Leah, page 443;

D.4 – Zoe, page 446; D.5 Nathalie, page 448). The cross-case analyses present similarities

and differences using the biopsychosocial lens and relevant theoretical frameworks and

literature to address the three research questions: 1. How do female ultra-athletes' pre-event

pain expectations and planned coping strategies influence their approach to ultra-endurance challenges? (Forethought Phase); 2. What cognitive processes do female ultra-athletes employ to interpret and respond to pain during ultra-events, and how do these processes interact with environmental and biopsychosocial factors in naturalistic settings? (Performance Phase); 3. How does post-event reflection on pain experiences contribute to the development of future pain coping strategies and performance enhancement? (Self-Reflection Phase)

**Figure 5.3**

*The Cross-Case T-Score Results for the Pre-Event SIP Inventory.*
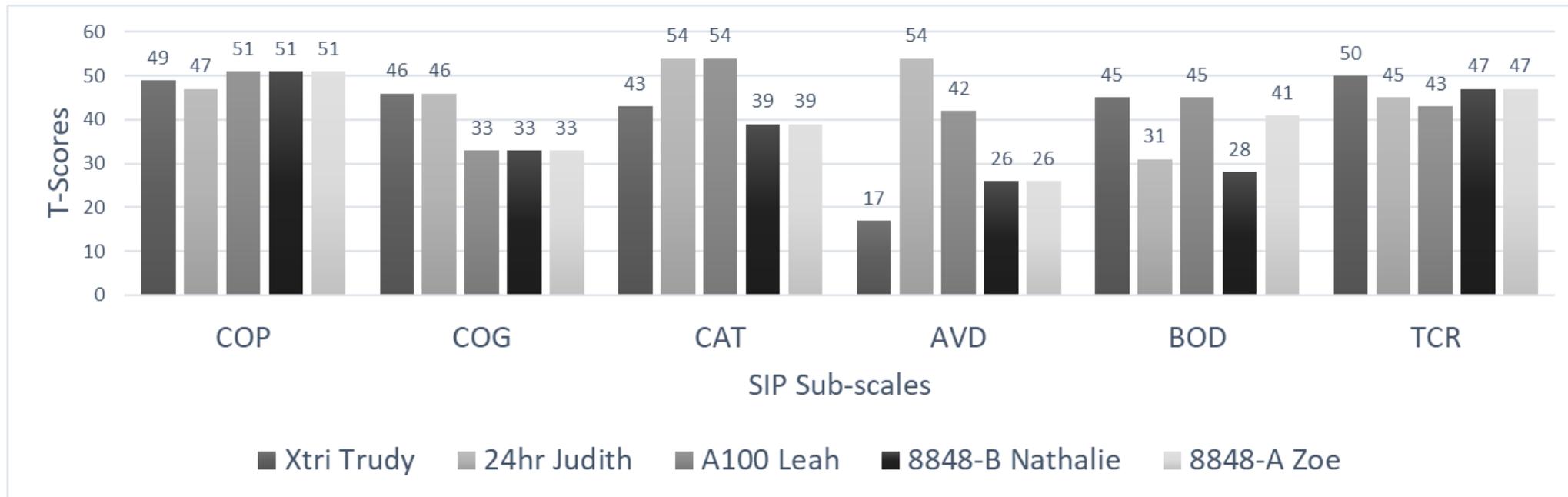


Key: XTri Trudy = triathlon; 24-hr Judith = track run; A100 Leah = trail run; 8848-B = Nathalie; 8848-A = Zoe (8848-Everest Cycle challenge)

*Notes*: direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al., 1992).

Total coping response score (TCR = COP + COG - CAT) which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain.

Analysis of pain experiences across five different ultra-endurance sports developed two overarching themes: Learning from Pain Experience and Importance of Support. These themes manifested distinctly across temporal phases (pre-event, during-event, and post-event), demonstrating how athletes develop and implement pain coping strategies while drawing on various forms of support. The following sections examine how these themes evolved through different temporal phases, illuminating the cyclical nature of learning in ultra-endurance sports.

### 5.3.1 Theme 1: Learning from Pain Experience

This theme encompasses how athletes developed, implemented, and refined their understanding of pain and pain management strategies across temporal phases. The think-aloud protocols demonstrated how this learning process occurred in real-time, while pre- and post-event data demonstrated how experiences were integrated into athletes' broader understanding.

*Pre-Event Learning and Preparation.*

In examining pre-event expectations and planning, the analysis demonstrated how athletes developed pain differentiation abilities through years of experience. This aligns with the assertion from Brick et al. (2016) that task-relevant monitoring of body sensations and cognitions are likely developed through relevant experience. For example, all five athletes demonstrated the ability to distinguish between exercise-related and injury-related pain, which directly influenced their pre-event preparation strategies. This developed a confidence and self-belief of how pre-event pain expectations shaped ultra-endurance preparation by showing that experienced athletes develop detailed mental catalogues of pain types that inform their planning. This contributed new understanding about how pain management capabilities develop over time based on previous experiential learning extending the work of

Jackman et al. (2024a) for goal striving and showing how athletes specifically contrast their desired performance goals against their current pain experiences.

The analysis showed that athletes engaged in deliberate pre-planning of pain coping strategies, which aligns with McCormick et al.'s (2019) emphasis on the forethought phase of self-regulation phase (Zimmerman, 2001), involving task analysis and self-motivational beliefs. For example, the pre-event preparedness for coping with the psychological and physical demands of the events were evidenced from four of the five athletes, to facilitate their high self-efficacy in completing their individual events. Both Trudy and Judith had to consider their nutrition strategy due to expected gastrointestinal issues. Similarly, recalling past experiences of event-related pain and reviewing, Leah had built up a range of specific strategies personalised to her stomach pain, chronic niggles, and other unexpected occurrences. Trudy needed to plan even further ahead and had completed two years of cold immersion training to practice and acclimatise to the confident feeling of swimming a mile in 12 degrees cold water in the dark hours of the early morning. This specific training transformed pain experience not just through increased physiological tolerance but through sensory adaptation, like other swimmers (Throsby, 2013) showing that thermoceptive analysis became familiar and restorative, revealing that training changes how pain feels, not just how much can be endured (Throsby, 2013).

In a shorter temporal frame, two weeks before confirming her race entry, Trudy needed to assess her foot injury pain through long training runs, testing actual pain intensity, tissue response, and her tolerance levels under race-like conditions. Psychologically, her confidence for racing depended on this biological testing. Furthermore, Trudy recounted her sports doctor's guidance which she interpreted as medical authorisation for pain tolerance with conditional safety parameters—race would not cause further tissue damage, but it was dependent on how much pain she could cope with. This exemplified biopsychosocial

integration in professional athlete decision-making. Trudy's choice to race was not driven by external pressure but represented autonomous, informed decision-making based on integrated information: biological data (pain intensity during testing), psychological assessment (confidence in pain tolerance capacity), and social resources (medical expertise providing risk assessment and authorisation). Her pragmatic approach—racing only if pain was tolerable and non-damaging—reflected professional athlete culture's instrumental relationship to bodily pain (Malcolm & Sheard, 2002; Roderick, 2006), where her body operated as her work tool requiring calculated risk management. Trudy's approach aligned with Bursik et al.'s (2025) conceptualisation of active risk management in elite sport, wherein athletes demonstrate calculated risk-taking rather than passive acceptance of injury risks. Trudy's systematic testing of her foot injury, consultation with medical professionals, and conditional decision-making exemplified fluctuating prioritisation of health or success. Professional athletes continuously re-evaluate the risk-reward balance based on situational factors such as injury severity, competitive importance, and medical guidance. This real-time documentation of pre-event risk assessment extends Bursik et al.'s findings by capturing the decision-making process as it unfolded across the pre-event period.

This testing of pain and reviewing fits well with the self-regulation skills of self-monitoring and reviewing to develop their metacognition of 'knowing' their bodies and capabilities (Brick et al., 2015; Zimmerman, 2000) where athletes needed these essential skills for the longevity of their ultra-participation and long-term physical wellbeing. This was especially true for Trudy, a professional athlete, who viewed her body as her "work tool". Judith and Leah had both learnt from experience that to ignore pain and be in denial could cost them a more serious injury and time off from running from previously doing just that with a back stress fracture. Leah recognised within herself the risk of exercise dependence

and so controlled this temptation by not running when injured and by removing a set goal to run every day.

Lev (2019) suggested a social value of learning to recognise and gain pleasure from pain but for Trudy and the other athletes, injury-related pain signalled the potential of not being able to train and compete. Hence it was important to be able to assign meaning and internalise the 'right' bio-medical discourse to be able to continue with their sport (Shipway & Holloway, 2010). As all athletes had accumulated years of competition experience, attentional focus, and meaning between different types and quality of pain and discomfort (Melzack, 1987, 2001) their learning firsthand to recognise bodily symptoms enabled her to develop categories of bodily sensations and know her body (Lev, 2019). Internal sensory monitoring and active self-regulation pre-event illustrated metacognitive feelings of confidence, difficulty, knowing, and familiarity to cope in the race (Brick et al., 2015). For example, in preparation for the race pain, Judith reflected on her accumulated experiential learning:

> Unless there is something that is like September's race where my knee the tracking felt wrong and there was a multitude of things, there would be no reason why I couldn't run through certain pain thresholds …the great thing about being an endurance runner you have to be tougher and when I get into those moments where I feel pain a lot, I just tell myself you've…got two children you've gone through far worse you've got through this you can do this so that's when all the positive reinforcement comes in.

This quote illustrated biopsychosocial dimensions interacting simultaneously in Judith's forethought stage (Zimmerman, 2000). Biologically and psychologically, Judith demonstrated metacognitive awareness (Brick et al., 2015) through learning from a previous race pain experience. This cognitive-evaluative process—using memory of past pain to

interpret and anticipate future pain—reflects Melzack's (2001) Neuromatrix Theory, enabling her to differentiate dangerous pain requiring attention from tolerable pain thresholds she could manage. Her self-efficacy for coping with ultra-endurance pain was anchored in her unique gendered maternal experience: the childbirth comparison positioned athletic pain as manageable relative to this ultimate female pain reference point (Palmer & Leberman, 2009). Sociologically, her statement reflected internalisation of sport ethic ideology (Coakley, 2015; Hughes & Coakley, 1991), revealing her socialisation into ultra-endurance culture where pain tolerance is normalised as definitional requirement for legitimate athletic identity.

In preparation for the event, athletes' pre-event SIP scores highlighted a range of above and below the norm of 50 (see Figure 5.3, page 249 for cross-case results and notes). These scores on their own were difficult to predict the context for these results without the pre-event interviews for adding more rich detail to their background context and previous experiences. For example, analysing the catastrophising scale (CAT), Leah's CAT T-score was 54 and was going into the race with less fitness than she would have liked; Trudy's CAT T-score was 43 and was going into the race with a healing stomach ulcer and foot injury; and Judith's CAT T-score was 54 and was going into the race with high expectations, despite having a cold and poor sleep, as this was the last opportunity to qualify. In comparison, both Zoe and Nathalie's CAT T-scores were 39. Nathalie displayed a pragmatic stance pre-event, planning her equipment to prevent chafing and rubbing, using scenery and music for distraction, and reframing negative thoughts for positive ones. Nathalie perceived pain as a necessary part of the achievement process in her sport which was aligned with her SIP answer, agreeing with 'statement Pain is just part of my sport'. As well as stomach pain, negative pain was also related to Renaud's syndrome of poor circulation in her extremities but from experience she knew it always passed. Nathalie's experience had taught her to evaluate the seriousness of pain without catastrophising:

I have realised…in cycling that…back pain, a knee pain or anything else usually goes away the following day or after just like one or two days' rest, so in that case I usually take some kind of painkiller, Ibuprofen and keep going; I know it is just like if you change the saddle or the position of the bike for a few minutes it will go away.

Being a mum of two young children, Zoe was feeling "mom-guilt" which was compounded by her not feeling supported by her husband, family or friends for leaving the children to do the event:

As I'm speaking, I'm only realising in myself that actually the role I play as a woman in society also doesn't allow me to let my pain…take over d'ya know what I mean? I can't cos I already feel bad for doing what I'm doing…and I think that's quite a revelation for me.

Reflecting on this, Zoe recounted how the sociocultural influences and gendered norms of maternal responsibility over the years had shaped her high pain tolerance levels right from being a child, from being a 'people-pleaser' and not feeling able to express to her mum if she was hurt and in pain. Undertaking an ultra-endurance event requires a lot of hours and so not having the support made it difficult to express any pain experienced from injuries, niggles or exercise-related discomfort as she did not feel able to because it was "her choice". Friends would suggest a gym class instead of hours on a bike but the bike or run gave her "the hit" she needed more than a gym class or swimming session. Exercising was fundamental to Zoe's mental wellbeing and so enduring physical pain was far easier than the mental pain if she did not exercise. Hence her below the norm T-score for catastrophising. These psychosocial and cultural influences were not unique to Zoe as other ultra-athletes have been reported having a lack of partner support, gendered expectations, and social disapproval (Bean & Wimbs, 2021; Johansen et al., 2023). McGee et al.'s (2024) research on psychological maltreatment and conformity to the sport ethic provides additional context for

understanding how Zoe experienced pressure to suppress pain expression. Her pre-event reflection illustrated how sport ethic conformity intersected with gendered expectations—she felt compelled to demonstrate toughness not only as an athlete but also as a woman justifying time away from maternal responsibilities. This dual conformity pressure may intensify female ultra-athletes' pain tolerance expectations beyond those experienced by male athletes or non-mothers.

Leah's AVD T-score (42) possibly compensated for the lower COG T-score (33) as AVD represented avoidance strategies, save it until it counts but could also be interpreted as the prevention strategies she had in place as part of her systematic planning prior to the event based on her accumulated experience. This possibly was insightful to her state of mind for coping as back up due to the lack of training due to her mother's recent illness and death. Comparing the other AVD T scores for Trudy (17), Judith (54), Zoe (26) and Nathalie (26), there was a vast difference. For Nathalie and Zoe, they both relied on ignoring pain (COP 51 for both) perhaps indicating they had not had the experiential learning of a serious back stress fracture injury like Leah and Judith.

In summary, this cross-case analysis of pre-event learning from pain experiences showed that athletes showed clear task analysis and highlighted how athletes' beliefs influenced their preparation.

### Real-Time Learning and Adaptation.

**Pain experiences.** This section presents the interpretation of the during event data. Due to space constraints, please refer to Appendices: D.1 - Trudy, page 439; D.2 – Judith, page 441; D.3 – Leah, page 443; D.4 – Zoe, page 446; D.5 Nathalie, page 448 for joint display details highlighting athlete quotes for rich detail.

Trudy's during-event data demonstrated how environmental factors directly influenced her pain perception and coping strategies in real-time. When the cold weather

affected her hands during cycling, her verbalisations showed increasing frustration and mood changes that amplified her pain experience. Despite planning the cold-water pain, Trudy's forethought task analysis (Zimmerman, 2001) of the cold weather effects for on the bike had not been accounted for due to a lack of experience. For example, no overshoes on her feet also gave her cold feet pain: "ah my feet are so cold. Fuck me... feet are cold, hands are cold. Fuck…jesus." (2h17min).

Judith's think-aloud data during her 24-hour track event demonstrated how pain perception and coping strategies evolved with fatigue, illness, and 'constapoo' issues: "So I just had a toilet. First poo of the morning. Bit constipated but it was needed. Not quite sure if I'm completely done but I feel better now for going to the loo" [1h6min]. Early verbalisations showed active engagement with other runners: "Tell you what I feel about two stone lighter after that poo. Its soo uncomfortable [ref to pain] [speaking to someone who laughs saying you'll be flying] I don't normally get constapoo" showing how she used humour to reframe and cope with her GI discomfort issues. This was supported with frequent self-talk verbalisations: "Come on legs" [16h13mins], but as time progressed, there were notable periods of silence punctuated by singing to her specially chosen music playlists: "because sometimes to block out that pain is a good thing" [5h44min] explaining to a fellow runner. This showed how her pain management strategies shifted over time from lively, enthusiastic social interaction with other runners to music-based dissociation on her own. Her verbalisations also captured the immediate impact of gastro issues: "Just had some pasta. Couple of mouthfuls. And now I've got ginger again cos my guts are a bit funny" [12h9 mins] and environmental changes on mood: "Hate this end" [16h]. This response was to the back section of the track and showed how her tolerance to the cold wind had reached its saturation point directly affecting her pain experience and emotional state. This was also shared with support crew: "I know I'll have to put a base layer on tonight. It's definitely cold"

[6h16min] and a fellow runner: "just…depressed with the weather. Be nice to have a little bit of blue sky" [6h19min]. These cognitive strategies aligned with similar elite runners using active distraction and self-regulatory strategies:

So that's 51 miles it looks like in 7 hours and 10. I've been drinking a little bit of tea. Feeling a bit warmer but it's definitely getting cold now. The sun's gone down, well, it never really came up. Very breathless. No major injuries, just tight hamstrings as usual. But I'm just trying to ignore them, and I did a shoe change at 6 and a half hours. [7h09mins48secs].

Additionally, her verbalisations highlighted how her past experience helped her to maintain her pace by using outward monitoring and self-observation of her environment and the trackside lap board to stay on target for her qualifying goal (Brick et al., 2015; Jackman et al., 2024b; Zimmerman, 2001). and extends the work of Johnson et al. (2023) illustrating outward monitoring in a naturalistic setting. Her verbalisations captured low periods of fatigue, muscle pain, competing and competing with a cold. The positive effects of support interventions became evident towards the end: "It's now 13 hours and 6 minutes. Feeling a bit nauseous again. Everything's really tight on my legs" and the positive effects of napping and sports massage towards the end of during her 24h race: "Back on it after massage its now 21.5 hours. 2.5 hours to go … make this misery end. So cold…I've had a massage, I've had a sleep, I've had nausea, tight legs, everything". This captured Judith's resilience to adversity during the race and determination to finish and qualify for her goal.

Leah's data captured how grief and emotional state influenced her real-time pain perception across the 100-mile distance: [start of Leg 3: 03h37mins "7/8ths of the way through the Grand Slam I'm not going to stop now. It's only tired [there are tears in her voice, sounds upset] that's all. [sniffles]". This provided evidence towards highlighting the regulation of emotions and motivation in a real-world context (McCardle et al., 2019;

McCormick et al., 2019). Her verbalisations demonstrated a pivotal moment when she called her husband at the start of Leg 3 straight after her think aloud: "Feeling a bit low so I thought I'd phone you to cheer me up." This real-time data showed how social support served as an immediate pain management strategy and emotional pick me up, as well as making her feel safe running alone in the darkened environment. Her think-aloud process at the start of Leg 2 also revealed an unexpected insight about verbalisation itself: "What I'm finding interesting is, because normally I try not dwell on when I'm feeling bad, saying it out loud is actually quite difficult because that makes me think about it more. Something I hadn't considered". This trying not to dwell was a similar approach for all athletes and was similarly voiced by Nathalie during her bike ride.

This metacognitive awareness of how verbalisation affected her pain experience provides valuable insight into dissociation type pain coping mechanisms. Although as Whitehead et al. (2022) reported, Leah was able to continue without it disrupting her run as she just 'catalogued it' and moved on: "[During Leg 4 using voice activated mode: "…glutes, hamstrings, and quads all somewhat tired and stiffening up at 81.5 miles… my gut's not happy; my stomach's not happy. I think I ate too much at the last checkpoint" (24mins) followed later by [55mins] "injured my left big toe but it went away again, so no problem" and hours later, [1h43mins] "glutes still quite stiff. Actually, they're tight. [sound of gate clinking shut]…[1h44mins] Outer side of my left thigh just twinged again…let it pass". These progressive verbalisations clearly showed how regular internal body monitoring for severity and cause (Brick et al., 2015) aided Leah to continue her goal striving (Jackman et al., 2024a) and utilise her self-control processes of the performance phase of self-regulation (Zimmerman, 2001). This provided evidence towards confirming that an internal focus on body sensations during running does not necessarily disrupt movement efficiency (Schücker et al., 2014).

Zoe showed a stark contrast between Day 1 and Day 2, revealing how biopsychosocial influences interacted together to negatively influence her pain perceptions and tolerance. On Day 1, anxiety about starting in the dark, following others fast pace, lack of navigation confidence, topped off with guilt about leaving her children manifested into a more heightened pain sensitivity. For example, at the start of circuit 1 Zoe's verbalisations demonstrated how social comparison, anxiety, and low self-efficacy affected her pain tolerance (Bandura, 2003): "[17mins] what I think is I'm feeling really, like I can't, I'm not very good at cycling. [out of breath as speaking] there's lots of people racing ahead, when I know there's, and all I keep thinking is, I can't do the hurting". This self-doubt continued over to the start of circuit 2: [1min 47]: "Cycling in another country is…adds like another layer of tiredness, so it's like...I just don't feel in same…cycling ability as I am in my own in my own space. It's weird". These verbalisations illustrated how being out of her comfort zone, literally and metaphorically, made her mind and body feel completely disconnected to her environment as well as with her usual sense of herself. Zoe's metacognitive strategy to cope was by confiding in a fellow cyclist about feeling guilty and the lack of support at home. This resonated with similar findings creating communal understanding and social connections as critical to pain management (Hall & Rhodes, 2024; McNarry et al., 2021). This also aligned with how women are expected to manage pain alongside societal responsibilities, often leading to self-blame and reduced self-esteem (Samulowitz et al., 2018).

As the weather temperatures rose, and the pace settled down Zoe was feeling more relaxed while conducting internal sensory monitoring and pain processing (Brick et al., 2015; Melzack, 2001) evaluating different aches and pains came and went and moved around the body during circuit 1: [1h39.21]. "Left leg feels like a wooden leg right now" and at [1h42.50]. "I've got this thing on my knee where I packed my bag too much, it's rubbing. My toes are a bit numb on the left leg but that comes and goes. If that comes and goes its ok".

This temporal evaluation of sensory information helped Zoe with her active self-regulation (Brick et al., 2015). In circuit 2, as the physical fatigue and psychological anxiety returned, mood affected her pain perceptions and coping: [circuit 2: Voice activation mode: (1h03.50). "My whole left side is really uncomfortable…everything I said yesterday [pre-event interview] about ignoring pain is ... not happening for me today" illustrating that usual familiar abilities were negatively affected.

By the first checkpoint before climbing up to the Col du Tourmalet summit, this peaked to: "…I can't even think, I'm in a world of pain. and I have to keep stopping [really out of breath]…I nearly didn't come up here I was in such a bad place". However, determined to reach the summit, Zoe pushed through demonstrating that despite her mental and physical struggles she was resilient and determined to keep going: [voice activation mode: 1h11.37 -making way to Tourmalet summit] "Come on, come on, everywhere hurts [hard to hear as feint and suffering by intonation] come on, [struggling] f****n hell, [very heavy panting, very windy so hard to hear as she almost whispers words out in sufferance] ..could do with stopping at the end [very hard to hear] I'm really struggling [very windy] still struggling.." This showed how immediate pain processing and self-talk were inseparable.

Towards the end of the 2nd circuit, Zoe's real-time metacognitive awareness of her mental and physical state was enlightening to herself: [voice activation mode: 2h37mins]

cos I'm just concentrating on getting back and nothings really hurting, well it is, like its stiff which I think that's interesting because how my mental state really does, you know, drive my pain is something to think about, it really is. I felt crap for the first, well I felt crap for the last hour of the first loop, and I basically felt crap until I got to the top of Tourmalet.

This feeling of knowing and reflecting on this through verbalisations made her realise how important it was to reframe and keep a positive mental state for future cycling. By Day

2, on the final third circuit, Zoe was already displaying self-regulatory skills of self-reflection by just reflecting on her self-awareness and how the new environment and interacting biopsychosocial factors had affected her on the first day: [43mins] "Feeling like you know what, I feel like in an event…is a whole different ball game and…being here's learning loads of things…because it's important for myself". Despite perfect temperatures and beautiful scenery Zoe was still not able to escape her gendered norms of social responsibilities: [1h31mins] "…I feel a bit guilty being away for 5 days actually. Anyway I'm here now. I feel guilty that they're not abroad". Further self-reflections indicated the psychosocial paradox of riding with others for support and navigation on day 1 but this had created stress and pressure for her go at others pace: [1h44mins]. "Yesterday…I just felt so rubbish and now I just feel back to normal, I'm on it. I feel good. I think it's cos I'm on my own. I normally cycle on my own.". This real-time self-reflection was evident in terms of being self-aware of how her mood could affect her and interactions as well as on pain perceptions: [2h] "…sometimes you just have to go into yourself, into your little hole, and remembering…I was in labour…and I had to go to a dark toilet and crouch and I just told everyone to go away". This unique gendered insight showed how pain expression was dealt with my seeking solace. This real-time comparison provided unique gendered insight into how psychological state modulates pain perception. This provided similar evidence towards the importance of emotion regulation for performance for coping with pain during events (McCardle et al., 2019; McCormick et al., 2019). Zoe verbalised motivational self-talk to herself when needed for the tough climbs demonstrating self-observation and active self-regulation (Brick et al., 2015; Zimmerman, 2001).

Nathalie's think-aloud data demonstrated her active cognitive strategies for pain management, particularly her explicit rejection of pain. When encountered at the first pain checkpoint, she laughed about forgetting her lower back pain: [03h09mins] "It's funny I saw

you, you asked me about pain, and I totally forgot about my lower back pain cos it is not the usual one and I refuse to accept it. I know the knee one so I know it is going to go away so I forget about it...I just refuse to accept it; I ignore it there is no lower back pain funny" (Route 1). Her verbalisations shortly after starting the second circuit after lunch, captured the immediate negotiation between acknowledging and ignoring pain:

So, talking about, body check. If I listen to my body right now everything will hurt so my right shoulder is saying yeaaah, my lower back is kind of like 'hello!' my right thigh it is like 'coocoo' …not gonna listen to you gonna put some music on. That's all. No more body check right now, not useful. [22mins]

This real-time data of internal sensory monitoring and pain processing (Brick et al., 2015; Melzack, 2001) showed how she consciously modulated her attention to manage pain, something that might be difficult to capture in post-event interviews. This aligned with her pre-event SIP COP T-score to ignore pain. The transient and temporal nature of pain and discomfort from effort was illustrated 2km to the summit of the Col du Tourmalet ascent:

I am not going to pretend it's easy. My knees, can feel my knees, like they are still heavy, rest OK, need to keep pushing  (pause of a few seconds) and again this is not pain cos it's er constant effort there is no like stiff pain somewhere or something that's burning or really unpleasant I just generally an effort that is how I am going to call it. [03h28mins]

This was contrasted after her burning knee sensations subsided on the descent: [4h] "It's funny how easy you forget pain going down" highlighting the exercise induced related pain and discomfort.

During her verbalisations, active distraction strategies (Brick et al., 2015) were evident-music, podcasts, scenery observation, noting animals, positive self-talk and counting when it became tough on steep ascents: [2h09mins] One, two, three, four. One, two, three,

four. When I am counting you have to try to keep some rhythm and not to be too slow, so I count pedal strokes…(breathes hard). A la limite! On y ait là (on the limit. Nearly there). By Route 3, despite the accumulated distance, she maintained her approach: "No pain or anything and like I slept well actually...So feeling perfectly fine," demonstrating how effective recovery is aided with sleep to promote her pain rejection strategy.

These synopses (and joint display tables in appendices D1-D5, pages 439-448) emphasise the unique value of the during-event data by showing how pain experiences and coping strategies evolved in real-time, influenced by environmental conditions, emotional states, and pain, elements that might be lost or altered in retrospective accounts. From the cross-case analysis, several biopsychosocial and environmental factors highlighted similarities and differences for their influences. From a biological lens, for similarities, all athletes experienced pain and discomfort which were unique to themselves and their sports. Differences were in the gastrointestinal pains and how previous injury experiences influenced how athletes interpreted and responded to pain signals during their events. Sport-specific pain contexts patterns were elucidated - cyclists (Zoe and Nathalie) dealt with distinct saddle-related discomfort, while runners (Judith and Leah) managed impact-related pain from running surfaces. Individual conditions affected pain experience, for example, Nathalie's Raynaud's syndrome created unique challenges with extremity pain.

For the psychological similarities, all athletes demonstrated active cognitive strategies for managing pain, though their specific approaches varied. The think-aloud data provided unique sports-related real-time evidence of Gate Control Theory (Melzack & Casey, 1968) mechanisms in action during ultra-endurance performance. When athletes verbalised active cognitive engagement, such as Nathalie choosing to "ignore" pain and play music, or Trudy's decision to "internalise" pain, they were effectively demonstrating descending modulation of pain signals at the gate. Conversely, when mood deteriorated or anxiety increased, as

captured in Zoe's day 1 verbalisations "I can't even think, I'm in a world of pain", the gate appeared to open wider, allowing more pain signals to reach consciousness. These real-time cognitive-affective influences on pain perceptions provide ecological validation of gate control's theory central premise that pain is not simply a direct response input but is actively modulated by psychological factors. Mood was evident as a crucial mediator of pain perception across all cases. When mood was positive, athletes reported better pain tolerance and management.

Real-time observations extend Brick et al.'s (2015) Metacognitive Framework by providing naturalistic evidence of how attentional strategies are deployed during ultra-endurance events. When Nathalie verbalised "I refuse to accept it. I know the knee one, so I know it is going to go away," she demonstrated metacognitive knowledge (understanding derived from previous experiences) and metacognitive control (deliberately implementing an attentional strategy). This integration of theory with real-time data provides ecological validation of both Neuromatrix Theory's multidimensional conceptualisation of pain and the role of metacognitive processes in pain management during athletic performance. Some individual differences were highlighted like Zoe's pain experience was uniquely influenced by maternal guilt and anxiety, which significantly amplified her pain perception on Day 1 compared to Day 2. Similarly, Leah's emotional grief and mood influenced how she interpreted her early onset of pain due to lack of fitness: "yeah my mother's death happened and my training just collapsed the last 4 months so I just wanna finish" speaking to a fellow runner during running Leg 2 [she complains she's slower again saying cos of mothers final illness and death at aid station]. This was followed up with a think aloud 58 minutes into the leg: "…just tired, halfway. Just tired and remembering you've got the hardest…leg to go. And then horribly long boring one…It's tough". This highlighted her ongoing grieving process and how it influenced her perceptions of previous experiences running the race. The

professional status appeared to influence pain approach, with Trudy showing a more systematic evaluation of pain types, while amateur athletes like Leah and Zoe displayed more emotional responses to pain.

Examining the social similarities, social support proved crucial for pain management across all athletes, though they accessed it differently. For example, Nathalie and Leah called their partners during difficult moments of feeling alone and in pain, while Trudy and Judith relied on their designated support crew. All athletes used some form of social interaction as a pain management strategy, whether through direct conversation with other athletes or remote contact with supporters. The social differences highlighted that the structured support varied significantly. As stated, Judith and Trudy had dedicated support crews, while Leah, Zoe, and Nathalie managed independently, and for Leah it was a race rule to be self-sufficient apart from the designated aid stations. Zoe initially struggled with social comparison to other cyclists, while Nathalie preferred solitude, showing how social presence could either help or hinder pain management. Nathalie did not like the pressure of other cyclists following as this put pressure on her willingness to keep up a faster pace when she suffered stomach problems. This pressure resonated with other cyclists albeit professional, but this provided a real-time context rather than retrospective accounts (Kress & Statler, 2007). These biopsychosocial examples illustrate the relationship between pain tolerance development and goal achievement and how different types of pain influence goal striving decisions (Jackman et al., 2024a, b). Additionally, Nathalie's verbalisations captured examples of own discussions to herself relating to performance and sport ethic narratives (Hughes & Coakley, 1991) during her Everest challenge. Thinking out loud near the start of her final circuit she reflected on conversations with others, and concerns for her roommate:

I have been thinking of the conversation at breakfast this morning when, can't remember her name, a lady who was super motivated in her promotion of the

challenge she was like wow ever always the same. There is no way I am giving up and the two guys, one was just like tired and the other one they were all having breakfast he was thinking about it but yeah he was saying he was in pain, he had cramps all night, couldn't sleep, was done, I mean like, I read and, seems to be confirmed, the mental strength of woman is higher. [pedals silently then think aloud again] I am wondering how [roommate] will manage with exhaustion and the mental energy to do it, must be a real challenge. Interesting. It's just like when, giving up is not an option and you know you can do it just get over it whatever your body's saying just like your mind is stronger. Kind of in a way, just like ignore any body signals. [1h06mins-breathless]

These verbalisations illustrated how sport ethic narratives (Hughes & Coakley, 1991) operated at both individual and comparative levels. Nathalie evaluated not only her own pain management through the lens of mental strength and refusing limits but also judged others' capabilities through these same cultural frameworks. Her gendered reflection revealed how performance narratives intersect with gender identity construction in ultra-endurance contexts.

As all the events were taking place in a naturalistic setting, the environmental factors and risks must be acknowledged for their influence on the athletes. For example, during the A100 running event: "train just went past nearby. For a moment I thought there was a car coming at a stupid pace round the corner" (Leg 2: 23 mins) and "have to watch the tree roots along here" (Leg 2: 58 minutes). This illustrated how attention was needed to different terrain from on and off-road situations while dealing with pain and discomfort. A multi-sport approach showed how different environmental contexts affected pain experiences and management. Findings address the call to better understand the interplay of athletes' self-processes and social agents and environment (McCardle et al., 2019). The environment plays

an important role in how learners self-regulate within Bandura's (1986, 1991) triad of the person, the environment, and their behaviour. The similarities illustrated how weather conditions significantly impacted pain perception and management across all athletes. Cold weather particularly affected Trudy, Judith, and Nathalie, while heat impacted Zoe and Nathalie. The terrain changes influenced pain perception and coping strategies for all athletes, requiring them to adapt their pain management approaches. In terms of the differences, the controlled environment of Judith's 400m track event created different challenges (monotony, repeated impact) compared to the varied terrain of the other events. These real-time examples extend the work of other think-aloud studies using single discipline and shorter duration (Johnson et al., 2023; Samson et al., 2017; Whitehead et al., 2021) highlighting long duration and distance external monitoring of terrain, road signs for distance to go, wildlife, and scenery. The time of day affected athletes differently, for example, Judith's 24-hour track event required specific nighttime pain management strategies, while cyclists dealt more with daytime heat management. The navigation challenges created additional psychological stress for some Zoe as she was in a different location but not others as the route were marked out with people helping. Nathalie benefitted from her experience on French roads and using a GPS device unlike Zoe.

The real-time data collection captured how these factors interacted dynamically throughout the events. For example, it showed how weather changes immediately affected mood and pain perception, how social support was accessed in moments of crisis, and how athletes actively modified their pain management strategies based on changing conditions. This temporal dimension provides insights that might be lost in retrospective accounts and helped to understand how biopsychosocial and environmental factors combine to create unique pain experiences for each athlete. These findings suggest that while there are common patterns in how ultra-endurance athletes experience and manage pain, individual differences

in biological condition, psychological state, social support, and environmental context create unique challenges that require personalised pain management strategies. The think-aloud protocols captured how athletes actively learned and adapted their pain management strategies during events. This real-time learning manifested differently across sporting contexts.

**Pain coping.** The cross-case analysis highlighted context-dependent coping strategies that developed from the during-event data, focusing on how different sports and their associated risks influenced pain management approaches. These real-time coping strategies directly illustrate the metacognitive processes outline by Brick et al.'s (2015) framework. Specifically, the think-aloud data captured athletes actively engaging in what Brick et al. (2015) describe as metacognitive monitoring (assessing pain state), metacognitive control (selecting and implementing appropriate coping strategies), and metacognitive experiences (feelings of confidence or difficulty that informed strategy adjustments). For example, running-specific coping strategies for track running (Judith), included: direction changes every 4 hours to manage repetitive impact stress; deliberate walk breaks at specific intervals to prevent overload; music as a key coping mechanism for monotony and psychological fatigue; and support crew providing trackside massages to manage developing muscle pain. These strategies addressed the specific risks of continuous repetitive impact and psychological monotony in track events. For trail running (Leah), context-specific strategies included: strategic shoe changes at checkpoints to prevent blister development; walk-run patterns adapted to terrain changes; using other runners for safety during night sections; and careful pacing on technical sections to prevent injury. These strategies specifically addressed the risks of terrain variability and isolation in trail environments.

For cycling-specific strategies (Trudy, Zoe and Nathalie), position changes on the bike to manage saddle discomfort, careful descent management to balance speed with safety;

strategic use of gearing to manage leg pain on climbs; monitoring for signs of dehydration and heat exhaustion; and navigation-specific coping strategies were employed. These strategies addressed the unique risks of prolonged seated position, high-speed descents, and the need to self-navigate. For triathlon-specific strategies (Trudy), specific transition management to prevent cold-induced pain; cross-disciplinary pain management (managing swim-induced shoulder pain during cycling); equipment adaptations (hand warmers) for environmental challenges; and careful nutrition timing to prevent gastric distress across disciplines. These strategies addressed the complex risks of managing multiple disciplines and transition periods. There were some sport-independent strategies which were common across sports but implemented differently based on context. For example, all athletes used chunking strategies, but the units varied: Judith used lap counts, Leah used checkpoint distances, Zoe and Nathalie used kilometre markers and altitude gains; and Trudy used discipline transitions as mental markers.

Due to the naturalistic nature of all the sports, different environmental risk management strategies were evident: Zoe and Nathalie needed specific strategies for tunnels and traffic, and avoiding animals on the road; Leah needed strategies for isolation and darkness; Judith needed strategies for weather exposure without shelter apart from when she took a rest inside when feeling unwell; and Trudy needed strategies for multiple environment transitions. The cross-sport comparative analysis showed important distinctions in how environmental contexts shape pain management requirements. While Judith's track environment presented challenges related to repetitive impact and monotony, Trudy's multi-discipline triathlon demanded rapid adaptation to changing environmental conditions. Trail runners like Leah faced unpredictable terrain that required constant vigilance and adaptation, while cyclists managed extended periods in fixed positions with intermittent terrain challenges. These sport-specific differences in environmental demands demonstrate how pain

management strategies must be contextualised within the specific performance environment, extending previous research that has typically examined pain coping within single-sport contexts. The real-time data showed how athletes actively modified these strategies based on immediate conditions. For example, when Trudy's hands became too cold to access food during cycling, the support crew adapted by providing hand warmers, a strategy that would not be relevant in track running but was crucial for ultra-triathlon performance.

This analysis suggests that while some pain coping strategies are universal, their implementation is highly context dependent. The real-time data collection was particularly valuable in showing how athletes adapted these strategies based on immediate sport-specific challenges and risks and illustrates the dynamic and multidimensional self-regulatory processes taking place (Zimmerman, 2001). This understanding could be valuable for developing sport-specific pain management protocols and risk mitigation strategies for ultra-endurance events.

The relationship between athletes' pre-event SIP scores and their actual coping behaviours during events highlighted both predictive patterns and contextual adaptations. Nathalie's high direct coping (COP) T-score of 51 accurately predicted her observed tendency to actively ignore pain during her event, exemplified when she stated 'I refuse to accept it. I know the knee one, so I know it is going to go away.' Similarly, Zoe's below-norm catastrophising (CAT) T-score of 39 aligned with her ability to reframe her pain perception between Day 1 and Day 2, despite challenging conditions. However, some patterns deviated from what SIP scores might predict. Despite Judith's elevated catastrophising (CAT) T-score of 54, she demonstrated effective active self-regulatory strategies throughout her event, suggesting that her high avoidance (AVD) T-score of 54 may have played a more dominant role in her actual coping approach, as evidenced by her strategic walk breaks and careful

pacing. It's important to acknowledge the inherent limitations of using the SIP as a one-off pre-event measure to predict pain coping during ultra-endurance events.

The think-aloud data illustrated how pain experiences and coping strategies were continuously reshaped by the complex interplay of biopsychosocial and environmental factors that could not be anticipated by any static pre-event measure. This observation highlights the methodological value of combining quantitative inventories with real-time qualitative data collection to capture the dynamic nature of pain experiences in naturalistic settings. These observations align with Zimmerman's (2001) concept of self-regulatory adaptability, where athletes modify their pre-planned strategies based on real-time feedback during the performance phase. The integration of the SIP quantitative measures with the qualitative real-time data provides a more comprehensive understanding of how pre-event dispositions interact with environmental and contextual factors to influence pain coping during ultra-endurance events.

### *Post-Event Integration of Learning.*

Post-event interviews elucidated how athletes processed their experiences and integrated new learning into their understanding. For example, Trudy was reflecting on her think aloud responses to pain during her run: "I needed to internalise this pain cos I was vocalising the pain cos it's admitting it's unbearable and it is bearable." This illustrated how her sport ethic of pain tolerance was influencing her strategy change during Trudy's performance phase of self-regulation (Zimmerman, 2001). Her self-control processes were actively modified from external swearing responses to a deliberate pain suppression strategy. Zoe's reflection on how psychological state influenced her pain perception: "My mental state played a massive part on both pain on self-esteem, on self-confidence", demonstrated an integration of experience and self-awareness into future preparation strategies. The reflections aligned with the self-judgement reflections within the self-regulation reflection

phase (Zimmerman, 2001), where Zoe was using causal attribution trying to understand why her usual pain coping strategies were different across the two-day event. Similarly, Leah evaluated her performance against her pre-race goals and acknowledged how grief affected her preparation. She also attributed the slower walk-run pace of her fellow runner on the final running leg to her not achieving a faster time. Additionally, the athletes showed both adaptive and defensive reactions, for example, they all displayed learning from experiences to refine future strategies, and some athletes protected their self-efficacy by attributing poor performance to external factors.

### 5.3.2 Theme 2: Importance of Support

The second major theme, Importance of Support, intersects with all three research questions by showing how social and professional support systems influence pain experiences and coping strategies across the temporal phases of ultra-endurance events. This theme particularly enriches understanding of how environmental and biopsychosocial factors interact with ultra-athletes' pain experiences in naturalistic settings. The cross-case analysis highlighted the importance of support, across all three temporal dimensions, for the athlete's wellbeing and pain coping. The similarities and differences for the type of support ranged from requiring a designated support crew, interdisciplinary practitioner support, fellow athletes, family, and friends.

The quality and nature of crew support directly influenced athletes' pain experiences through multiple pathways within the biopsychosocial model. Support networks demonstrated significant impact on pain perception and management through three primary mechanisms consistent with Rees and Hardy's (2000) multidimensional framework: tangible support using biological interventions (e.g., timing of nutrition, hydration, and pain relief), psychological factors that included esteem and emotional support (e.g., emotional security and confidence building), and the relational foundation enabling these exchanges within

social elements (e.g., established relationships and trust). This multifaceted influence aligns with Zimmerman's (2001) performance phase, where social resources are actively utilised for self-control and self-observation during task execution, while also supporting Brick et al.'s (2015) Metacognitive Framework through the facilitation of refined pain monitoring strategies.

**Support Crew.**

Pre-event two athletes needed to put together a support crew to compete in their events: the 24-hour track GB qualifier for Judith and Norseman X-Triathlon for Trudy. The key difference between these athlete's support was that Judith benefited from an experienced crew who were a successful group dynamic of two friends who had built up tacit knowledge of her support needs from motivating her, nutrition, hydration, music, equipment and clothes changes, and pain relief such as deep heat, paracetamol if needed permitted and massage. This aligned with recommended effective multidimensional support relationships that require time investment to build trust and understanding (Moore, 2019; Rees & Hardy, 2000). This preparedness linked to the first theme, interweaving into ensuring Judith's health and wellbeing before and during the events. Post-event they would always review if improvements could be made for the next race. Judith's two-person crew exemplified Moore's (2019) concept of a tight team wrapped around the athlete on race day, where quality of relationship and accumulated experience proved most valuable to her performance.

The environmental context significantly shaped how support networks influenced pain experiences. For instance, Trudy's reliance on local volunteers within the country she was racing in to be crew support required precise communication and planning to speed up the trust and understanding she required to meet her support needs, demonstrating how environmental constraints necessitate different approaches to pain management. A simple self-reflective process with the volunteers after the event helped Trudy to refine her approach

and inform future crew. This was further exemplified in the contrast between supported

events and those without crews, such as the Everest bike Challenge and Autumn 100 ultra

trail. These varying environmental contexts required athletes to adapt their metacognitive

strategies based on available support, supporting Brick et al.'s (2015) emphasis on flexible

attention regulation and goal striving (Jackman et al., 2024a, b). This planning from the

athletes aligns with both the task analysis class of the forethought phase in Zimmerman's

(2001) self-regulation theoretical framework and the Metacognitive Framework's emphasis

on attentional focus and cognitive control (Brick et al., 2015).

### *Professional Practitioner Support.*

Beyond the immediate support crew, athletes relied on a network of professional

practitioners who provided specialised expertise. This interdisciplinary support network

played a distinct but complementary role to the race-day support crew, comprising

physiotherapists, nutritionists, strength and conditioning specialists, coaches, sports doctors,

sport psychologists, sports masseurs, and osteopaths. Whereas these practitioners worked in

isolation, their collective impact demonstrated the importance of a comprehensive

biopsychosocial approach to pain management which aligns with recommendations for elite

athletes' pain management (Hainline et al., 2017; Maw, 2019; Moore, 2019). For instance, as

gastrointestinal pain issues were a potential issue for four out of the five athletes, two had

consulted with a nutritionist for specific strategies to manage their expected stomach pain.

The findings highlighted specific ways practitioners can enhance athletes' pain coping

abilities through different dimensions of social support (Rees & Hardy, 2000). First,

practitioners should focus on building athletes' pain-related self-efficacy through education

about normal pain responses and clear guidelines about when pain signals danger versus

expected discomfort. This aligns with Brick et al.'s Metacognitive Framework (2015) by

helping athletes develop more tacit pain monitoring strategies. Second, practitioners should

coordinate care to ensure consistent messaging about pain management, as demonstrated in Trudy's case where medical advice aligned with her performance goals. This coordination supports athletes' self-regulatory capabilities by providing clear parameters for strategic planning and performance monitoring (Jackman et al., 2024b; McCardle et al., 2019; Zimmerman, 2001). This approach was exemplified in Trudy's case, where her sports doctor's advice aligned with other similar athletes, confirming that it is possible to ignore their pain if they were reassured it would incur no further damage. This open communication and risk-taking about pain demonstrated the value of interdisciplinary support and understanding the athlete pain experience from a biopsychosocial perspective. Based on established trust-based relationships and clear contracting about expectations and risks, medical practitioners in elite sport have a critical role in helping athletes distinguish between pain that signals danger versus expected discomfort, while navigating the ethical tension between performance optimisation and long-term wellbeing (Hamilton, 2019). During the event, Judith's use of trackside sports massage to ameliorate muscle pains illustrated how immediate professional support can directly influence pain perception and management.

***Partner, Family, Friends, Fellow Athletes.***

While professional and crew support focused primarily on performance-related aspects, the athletes' personal support networks influenced their broader relationship with ultra-endurance participation and pain management. Drawing on Rees and Hardy's (2000) multidimensional conceptualisation of social support, the analysis revealed how emotional support (comfort during stress), esteem support (confidence-building), informational support (strategic advice), and tangible support (practical assistance) operated differently across athletes' experiences and across the forethought, performance, and self-reflection phases of self-regulation (Zimmerman, 2001). The analysis highlighted significant variations in how these personal support structures affected athletes' experiences, particularly in relation to their

pain coping strategies. For instance, Zoe's perceived lack of tangible support (Rees & Hardy, 2000) manifested as guilt about family responsibilities, influencing her pain management capabilities. Like other 'mom' athletes she needed to develop careful planning strategies to minimise the impact of training on family responsibilities, thereby reducing potential resistance (Bean & Wimbs, 2021; Johansen et al., 2023). Conversely, Leah's partner provided crucial psychological emotional support (e.g., comfort and security) during nighttime sessions, while Zoe's experience with fellow riders demonstrated how esteem support from them (e.g., encouragement and validation) could either enhance or impede pain coping mechanisms. Thus, highlighting how the role of personal support networks in pain management varied significantly based on environmental and social contexts.

These findings extend both Zimmerman's (2001) Self-Regulation Theory and Brick et al.'s (2015) Metacognitive Framework by demonstrating how different dimensions of social support (Rees & Hardy, 2000) influence all phases of self-regulation in ultra-endurance contexts. The think-aloud data captured the cyclical and recursive nature of self-regulation cycles during a single event. In the forethought phase, support networks contributed to athletes' systematic task analysis by facilitating goal-setting and strategic planning for pain management (Zimmerman, 2001). The present findings demonstrated how different support dimensions (Rees & Hardy, 2000) operated during pre-event preparation: informational support helped athletes develop systematic planning strategies (e.g., advice on training schedules, pain management techniques). During the performance phase, real-time verbalisations captured the implementation of self-control processes (e.g., Trudy's internalisation of pain) and self-observation (e.g., Leah's body monitoring) consistent with metacognitive frameworks (Brick et al., 2015), with crews acting on athletes' feedback to assist with strategy adjustments by providing informational and tangible support through practical interventions (Rees & Hardy, 2000). This aligned with reactive control (Bandura,

1997) when the adjustment of pain coping strategies led to the support crew providing Trudy with hand warmers and Judith having a sports massage. In the self-reflection phase, post-event interviews demonstrated self-evaluation processes and attributional thinking that directly influenced future forethought, complementing Zimmermans self-regulatory cycle. During this phase, emotional support (reassurance and comfort after difficult experiences) and informational support (helping athletes reframe attributions and extract learning) from personal networks proved crucial in maintaining motivation for future events (Rees & Hardy, 2000), suggesting that support dimensions operate cyclically across self-regulatory phases.

### 5.3.3 Contributions to Knowledge and Practice

This investigation contributes to both methodological approaches and theoretical understanding in ultra-endurance research. These advances emerge through three primary pathways: methodological innovation, theoretical integration, and practical application.

***Methodological Innovations in Think-Aloud Research.***

The study advances think-aloud methodology in sport psychology research. Building on McGreary et al.'s (2025) framework, this study demonstrated how think-aloud protocols can be effectively deployed in ecologically valid settings across different ultra-endurance sports. The successful implementation of think-aloud during events like the Norseman X-Triathlon and 24-hour track racing provides a blueprint for capturing real-time cognitive processes during extended competitive events, addressing a notable gap in the literature where think-aloud has traditionally been applied to shorter duration activities.

The multi-method approach adopted in this study exemplifies the best practices in think-aloud research. By integrating concurrent think-aloud protocols with pre- and post-event interviews, standardised pain inventories (SIP), and structured pain assessment checkpoints (McGill Pain Questionnaire), the study demonstrates how multiple data sources can enhance the ecological validity and richness of findings, ensuring data captured pain

experiences as they naturally occurred in competitive ultra-endurance contexts (Burke, 2016). This methodological triangulation proved particularly valuable for understanding how athletes' pain perceptions and coping strategies evolved throughout ultra-endurance events.

Beyond technical innovation, this study extends understanding of how think-aloud methodology can capture individual differences and environmental influences. The cross-case analysis of five different sports reveals how environmental factors, including weather conditions, terrain, and time of day, shape athletes' cognitive processes and verbalisations. This addresses McGreary et al.'s (2025) call for research examining contextual influences on think-aloud data, particularly in endurance sports settings.

### *Theoretical Integration and Extension.*

The findings both align with and extend current understanding of how mothers balance ultra-endurance sport participation with family responsibilities. Recent work by Bean and Wimbs (2021) identified identity conflict and guilt as major themes for marathon-running mothers, particularly regarding societal expectations and time away from family. While the findings strongly resonate with these themes, as evidenced in Zoe's realisation about societal roles and pain expression, this study provides deeper insight into how psychological and social factors directly influence pain perception and management during ultra-endurance events.

Building on Jackman et al.'s (2024a, b) work on goal striving in ultra-endurance contexts, this investigation advances understanding of how pain experiences influence performance regulation and goal pursuit in several ways. First, the real-time think-aloud data demonstrated how self-regulatory cycles operate recursively within single events (as evidenced by Judith's multiple strategy adjustments across 24 hours) rather than only across separate training/competition episodes. Second, the cross-sport comparison revealed how metacognitive strategies for pain management are simultaneously sport-specific (e.g.,

cyclists' position adjustments vs. runners' walk-break strategies) and unified by common attentional control principles (Brick et al., 2015). Third, the integration of Zimmerman's (2001) self-regulation framework with sociological concepts (sport ethic, performance narratives, gendered expectations) demonstrated how cultural forces shape not only athletes' pain interpretations but also the self-regulatory strategies they deem legitimate to employ. This theoretical integration provides a foundation for understanding how athletes develop and implement pain management strategies while navigating both supportive relationships and cultural pressures.

The real-time data collection through think-aloud protocols illustrated how support networks shape not just the practical aspects of training, but the immediate experience of pain and implementation of coping strategies. Zoe's contrasting experiences between Days 1 and 2 of the Everest challenge particularly illustrated how psychological state - influenced by family support dynamics - directly affected pain tolerance and management capabilities. Such immediate cognitive processes and their relationship to support systems were not captured in previous work relying on retrospective interviews.

***Practical Significance and Applications.***

The practical significance of this work demonstrates how different support systems influence pain experiences across various sporting contexts and temporal phases. The findings suggest the need for coordinated interdisciplinary support that considers both universal principles and sport-specific demands. This has important implications for how we prepare and support athletes in ultra-endurance events, pointing toward more refined and integrated approaches to pain management.

The cross-sport comparison showed both common patterns and sport-specific variations in how support influences performance and pain management. This broader perspective helps identify which challenges are universal to ultra-endurance motherhood and

which are context-specific, allowing for more targeted support interventions. The integration of these findings with established theoretical frameworks provides stronger links for understanding how support networks influence pain experiences, suggesting that support aids performance not just through practical assistance, but by fundamentally influencing how athletes experience and manage pain during events.

The findings provide important insight into female ultra-athletes' unique pain experiences, particularly regarding socio-cultural influences. Zoe's verbalised experience of 'mom-guilt' affecting her pain perception illustrates how gendered social expectations can directly influence biopsychosocial pain processes in ways not typically captured in male-dominated ultra-endurance research. This extends retrospective accounts by Bean and Wimbs (2021) and Johansen et al. (2023) demonstrating real-time cognitive processing of these social pressures during performance. The methodological approach employed in this study proved particularly valuable for capturing these gender-specific dimensions of pain experience that might otherwise remain unexplored in ultra-endurance research.

**5.3.4 Implications for Interdisciplinary Practice.**

Building on the theoretical and methodological contributions outlined above, this research offers specific guidance for different practitioner groups working with ultra-endurance athletes which align with the recommendations from Hainline et al. (2017). For sport psychology practitioners, the real-time nature of the data emphasises the importance of developing specialised psychological skills training programs that help athletes build metacognitive monitoring abilities tailored to their sport's unique demands. This extends beyond generic pain management strategies to include sport-specific skills for recognising when different coping approaches are most appropriate and developing the flexibility to adapt these strategies as environmental conditions change. The findings suggest the need to develop assessment protocols that consider how support networks influence pain perception and

create individualised interventions that account for both sport-specific demands and family dynamics.

Medical practitioners (i.e., doctors, physiotherapists, osteopaths, chiropractors, sports massage therapist) should consider integrating social support assessment into injury evaluation and treatment planning. By coordinating with other practitioners, they can facilitate a consistent message about pain management, helping athletes develop accurate pain interpretation abilities while providing clear guidelines about pain interpretation. Additionally, developing treatment approaches that account for how psychological state influences pain experience would be beneficial.

For coaches and support staff several key recommendations are highlighted including building safe structured training environments that systematically develop pain coping strategies. Through deliberate pain management practice into regular training sessions and developing sport-specific support protocols, coaches can help build athletes' pain-related self-efficacy through progressive exposure while fostering key self-regulation skills (e.g. self-observation/monitoring, self-control, reviewing). This systematic approach to pain management training represents a significant advance in how to prepare athletes for ultra-endurance challenges. Additionally, helping support crews develop long-term relationships with athletes and creating communication systems that work within sport-specific and environmental constraints.

**5.3.5 Limitations and Considerations**

While this study encountered some commonly reported challenges with think-aloud implementation, particularly around data capture during high-intensity efforts and adverse windy weather conditions, it demonstrated that these limitations can be effectively managed through careful planning and the use of multiple data collection methods. The successful application of think-aloud across five demanding ultra-endurance events established its

viability as a method for studying extended duration athletic performances, addressing previous uncertainties about its suitability for longer events (McGreary et al., 2025). Additional considerations include variations in verbalisation style between athletes and the focus on female athletes, which, while providing valuable diversity to the think-aloud literature, suggests the need for broader sampling in future studies to enhance naturalistic generalisability (McGreary et al., 2024).

A methodological limitation of this study was the single-timepoint administration of the Sport Inventory for Pain (SIP) before events. While this provided valuable baseline data about athletes' dispositional approaches to pain, it could not capture how these tendencies might shift in response to the dynamic conditions encountered during ultra-events. The SIP, like many psychological inventories, was designed to measure relatively stable traits rather than state-dependent responses that fluctuate with environmental conditions, physiological states, and emotional experiences. The think-aloud data demonstrated considerable within-event variability in pain coping strategies that a single pre-event assessment could not predict. This highlights a broader challenge in ultra-endurance research: static measurement tools may have limited predictive validity in contexts characterised by extreme duration, environmental variability, and complex biopsychosocial interactions. However, this limitation also underscores the strength of the mixed-methods approach employed, as the qualitative data provided crucial context for interpreting quantitative results.

**5.3.6 Future Research Directions**

The study's findings highlighted several promising directions for future research. Methodologically, the integration of physiological measures with think-aloud protocols and the development of more robust data collection methods could enhance understanding of pain experiences. Theoretical advancement opportunities include examining how pain management capabilities develop over time and investigating strategy transfer between

sports. The practical application of these findings could be enhanced through testing sport-specific interventions and developing comprehensive support crew training programs.

Future research should explore the temporal stability of pain coping dispositions by administering the SIP at multiple timepoints, before, immediately after, and several weeks following ultra-endurance events. This approach would reveal whether significant ultra-endurance experiences alter athletes' self-reported pain coping tendencies, either temporarily or more permanently. A longitudinal design tracking SIP scores across multiple events could identify how pain coping strategies evolve through experiential learning and whether patterns of adaptation differ between novice and experienced ultra-athletes. Additionally, researchers might consider developing modified state versions of pain coping inventories that could be briefly administered during events at key checkpoints, allowing for direct comparison between dispositional tendencies and state-dependent responses. Such methodological innovations would enhance understanding of the dynamic relationship between trait-like pain coping dispositions and the contextual adaptations observed during ultra-endurance performance.

### 5.4 Conclusion

This investigation makes several contributions to the understanding of pain experiences in ultra-endurance sports while advancing methodological approaches in research. The study's successful integration of multiple data collection methods, emphasis on ecological validity, and detailed examination of individual differences provide a template for future researchers seeking to employ think-aloud methodology in challenging real-world athletic contexts. The two major themes, Learning from Pain Experience and Importance of Support, demonstrated the dynamic, context-dependent nature of pain perception and coping in ultra-endurance events. The findings illustrated how athletes develop increasingly subjective metacognitive strategies through experience, actively regulate their responses to

different pain types, and leverage support networks to enhance their performance capabilities. The athletes' experiences clearly demonstrated the three dimensions of pain described in Neuromatrix Theory: sensory-discriminative (physical sensation), as shown in Trudy's detailed cataloguing of physical sensations; affective-motivational (emotional responses), evident in Leah's acknowledgment of emotional impacts; and cognitive-evaluative (interpretation and meaning-making), demonstrated by Nathalie's deliberate cognitive strategy to manage perceptions.

The cyclical self-regulation process described by Zimmerman (2000) was evident across all participants, with each athlete engaging in unique combinations of forethought planning, performance monitoring and control, and post-event reflection. These processes were not isolated to individual temporal phases but formed a continuous cycle of learning and adaptation that evolved throughout athletic careers. By capturing real-time cognitive processes during actual ultra-events, combined with the pre-and post-event reflections, the findings provide unique insight into the complex, evolving sense-making of pain experiences. This ecological approach advances understanding of how biological, psychological, and social factors interact in naturalistic settings to shape female athletes' pain experiences. The practical implications of this work offer valuable guidance for interdisciplinary practitioners supporting female ultra-athletes, while the theoretical integration enhances understanding of the complex mechanisms underlying pain management in extreme endurance contexts. As ultra-endurance sports continue to grow in popularity, particularly among female athletes, these methodological innovations and theoretical insights provide a robust foundation for future research and practice. Analysis of the dynamic, context-dependent nature of pain experiences advance understanding of how biological, psychological, and social factors interact to shape performance in extreme endurance contexts. These findings not only enhance theoretical understanding of pain management processes but also provide practical

guidance for interdisciplinary practitioners supporting female ultra-athletes as they push the

boundaries of human performance.

## Chapter Six: Discussion

### 6.1 Introduction

This thesis examined how female ultra-endurance athletes experienced and managed pain through three studies using retrospective, longitudinal, and real-time temporal perspectives. The programme of research addressed three interconnected questions:

1. How do female ultra-endurance athletes perceive, evaluate, and make sense of their embodied lived pain experiences?

2. Does reflecting and learning from experience inform female ultra-endurance athletes' future participation and performance, pain experiences, and choice of coping strategies?

3. Which biopsychosocial factors influence how female ultra-endurance athletes interpret their overall pain experiences and coping strategies?

The three studies contributed to answering these questions through their specific temporal and biopsychosocial lens. This integration exemplifies what Harrison et al. (2020) term the '1+1=3 integration challenge,' where mixed methods integration produced insights about female ultra-athletes' pain experiences unavailable through component approaches alone. This was achieved via a multi phased mixed methods design incorporating retrospective interviews (Study 1), longitudinal monitoring (Study 2), and real-time naturalistic observation (Study 3). Firstly, Study 1 highlighted two major experiential themes: "I really pushed myself above and beyond the call of duties" and "Experience is gold." These themes demonstrated how 13 female ultra-endurance athletes developed pain interpretation abilities through years of accumulated experience. Participants exhibited tacit bodily awareness to differentiate between manageable exercise-induced discomfort and potential injury-related sensations that might necessitate withdrawal from competition or training. This

embodied knowledge developed through iterative experiential learning cycles, as athletes developed tacit understanding of their corporeal boundaries and limitations. The findings showed how participants' cognitive strategies for pain management, such as counting techniques, employing positive self-talk, and deliberately forcing smiles, evolved through trial-and-error processes across multiple competitive and training experiences. Notably, several participants' elevated pain tolerance thresholds appeared inextricably linked to previous life experiences. This included childhood trauma and challenging personal circumstances, which transformed into sources of resilience within sporting contexts. The findings from study 1 illuminated a critical tension between psychological and physical wellbeing, whereby participants' psychological dependence on regular training for maintaining mental equilibrium often created risks to physical health through overtraining practices. The dependence created a precarious balance between self-preservation and potential self-harm, where athletes continuously negotiated complex decisions about when to persevere through pain versus when to prioritise recovery. This biopsychosocial complexity demonstrated how pain in female ultra-endurance athletes was experienced not merely as physiological responses, but as multidimensional phenomena shaped by psychological interpretation, past experiences, and sociocultural influences.

Study 2 (Chapter 4) investigated how three female professional ultra-triathletes experienced pain across a 64-week competitive season, revealing two distinct themes. The first theme, "It's part of your job - life through the lens of a pro," demonstrated how professional identity fundamentally shaped pain interpretation and management strategies. The second theme, "The rise and fall of pain," documented the fluctuating nature of pain perceptions and tolerance levels according to individual timeline situations. Through weekly monitoring via journals, questionnaires (RESTQ-Sport for recovery-stress states, BRUMS for mood profiles, McGill Pain Inventory, SIP for pain coping), and periodic interviews, the

study demonstrated how multidimensional and subjective pain experiences fluctuated dramatically based on numerous biopsychosocial factors. Although at different career stages (neo-professional rookie, mid-career, late-career), all athletes demonstrated a heightened tacit bodily awareness to differentiate between functional pain (performance-related, purposeful) and threatening pain (injury-related, potentially harmful). Major injury events created new perceptual benchmarks that effectively "reset" athletes' pain scales, fundamentally altering how they evaluated subsequent pain experiences. The COVID-19 lockdown particularly illuminated how pain tolerance was tied to professional purpose rather than being an inherent trait, with athletes conceptualising pain not as something passively experienced but as something actively chosen when serving meaningful competitive goals. From a psychosocial perspective, pain management decisions were heavily influenced by career stage pressures. For example, the neo-professional demonstrated how transitional pressure could lead to overtraining while ignoring pain signals, the mid-career athlete navigating injury recovery while feeling time pressure about remaining competitive years, and the late-career athlete balanced final performance goals with transition planning. The findings emphasised the critical importance of properly balanced recovery periods and the necessity for comprehensive interdisciplinary support networks that understand the unique pain experiences of professional athletes, thereby supporting both physical and mental wellbeing throughout demanding competitive seasons.

Lastly, study 3 (Chapter 5) captured cognitions of five athletes, whose competitive level ranged from professional to recreational, during their chosen ultra-events (running, cycling, triathlon) and produced two overarching themes 'Learning from Pain Experience' and 'Importance of Support'. The first theme, 'Learning from Pain Experience', demonstrated how athletes developed their tacit pain differentiation abilities through multidimensional and subjective experiential learning cycles. Pre-event interviews aligned with the findings of

studies 1 and 2, showing how reflecting on past ultra-endurance pain experiences informed athletes' confidence for managing high pain levels and enabled them to distinguish between familiar, temporary pain, and potentially problematic sensations requiring closer self-monitoring. The think-aloud methodology during events provided unique insights into how biopsychosocial factors influenced pain perception and coping strategies in naturalistic settings. These factors included psychological state (Zoe's contrasting pain experiences between anxiety-filled Day 1 and calmer Day 2), environmental conditions (Trudy's unexpected hand pain from cold weather), physical challenges (gastrointestinal issues experienced by four athletes), and social factors ('mom guilt' affecting Zoe's pain tolerance). Pain management approaches were notably sport-specific, with runners employing direction changes and structured walk breaks (Judith), cyclists adjusting positions to address saddle discomfort (Nathalie and Zoe), and triathletes developing cross-disciplinary techniques (Trudy).

The second theme, 'Importance of Support', highlighted how multifaceted support networks influenced pain management. Athletes with dedicated support crews (the two elite participants) benefitted from immediate biological interventions (trackside massages, hand warmers), psychological reinforcement (motivational encouragement), and social stability from established relationships. In contrast, self-supported athletes developed alternative strategies, such as contacting partners during challenging moments (Leah and Nathalie) or forming temporary alliances with fellow competitors for distraction and chatting. Post-event interviews confirmed the multidimensional nature of experiential learning seen in Studies 1 and 2, with athletes integrating their recent experiences into refined understanding of pain management. This cyclical learning process, spanning pre-event preparation, during-event adaptation, and post-event reflection, demonstrated how ultra-endurance athletes

continuously develop their pain management capabilities through direct experience, social support, and deliberate reflection.

Taken together, the combined findings of this thesis advance understanding of ultra-endurance pain experiences as multifaceted, dynamic, and iterative in nature, highlighting gender-specific considerations previously underexplored in literature. Three overarching key findings were identified: 1) Development of tacit pain perception, 2) Learning from experience, and 3) Role of support systems. These findings will now be explored in the following sections, in greater depth, examining how the integrated theoretical frameworks (Neuromatrix Theory: Melzack, 2001; Gate Control Theory: Melzack & Casey, 1968; Self-Regulatory phases/processes: Zimmerman, 2000; and Metacognitive frameworks for attentional control: Brick et al., 2015), interlink within the specific temporal and biopsychosocial aspects of female ultra-athletes' pain experiences and coping.

## 6.2 Key Findings

### 6.2.1 Development of tacit pain perception

Observations analysed across the retrospective, longitudinal, and real-time ultra-endurance pain experiences emphasised the multidimensional and subjective learning cycle taking place to develop a heightened tacit bodily perception. This embodied wisdom of differentiating between pain types (outlined in Chapter 2 for examples) and severity was continuously updated, logging new and familiar types of sensory and affective pain during training and race experiences. This tacit understanding of different pain types resonated with other studies of ultra-athletes (Atkinson, 2008; Bluhm & Ravn, 2022; Bolling et al., 2019; Hanold, 2010). For example, Bluhm and Ravn (2022) found that elite runners distinguished between acidic pain expected during high-intensity efforts versus unexpected pain sensations that might signal injury. The same tacit capacity to contextualise pain by ascribing specific meaning to different sensations aligns with the thesis findings, although the three temporal

perspectives in this thesis extend this understanding to demonstrate the iterative self-regulatory learning that took place from self-monitoring and evaluation afterwards.

To be more specific, both behavioural forms of self-regulation (observing and adapting performance strategies) and covert forms (monitoring and adjusting thoughts and feelings) (Zimmerman, 2013) were evident in how the athletes demonstrated contextual learning through self-monitoring pain experiences in varying environmental conditions (e.g., cold weather, hilly terrain) and influenced by biopsychosocial factors (e.g., self-efficacy, motivation to hurt, anxiety issues, sleep deprivation, overtraining symptoms, hormonal fluctuations, sport ethic, and societal pressure). By reflecting on these multidimensional and dynamic pain experiences, the athletes enhanced their attention to detail for responding to future pain interpretations, such as if it would be temporary in nature and understanding their cause and potential severity to be further monitored to prevent injury as far as possible. Parallel to the self-regulation phases of developing this tacit bodily awareness (forethought, performance, and self-reflection; Zimmerman, 2001), tenets of Melzack's (2001) Neuromatrix Theory provided the biological context to explain this pain processing. This integration of biological mechanisms with environmental influences extends Thuany et al.'s (2023) ecological systems model by using a variety of ultra-sports disciplines beyond just running.

Furthermore, understanding this tacit bodily awareness through a phenomenological embodiment framework, the athletes' interpreted their pain through embodied consciousness shaped by sensory experiences, memory, and environmental engagement within their chosen sports (Allen-Collinson & Hockey, 2009). The athletes developed somatic knowledge and pain perception to distinguish normalised and manageable training-related pain from threatening injury-related sensations, developed through repeated bodily practice (Allen-Collinson & Jackman, 2022; Hockey & Allen-Collinson, 2016).

The focus on the different elements of these ultra-sport disciplines demonstrated how athletes' experiences developed from the interaction between individual characteristics and environmental factors across different sporting contexts and disciplines. Additionally, the sensory-discriminative, motivational-affective, and cognitive-evaluative components align with Melzack and Casey's (1968) Gate Control Theory, which explains how psychological factors can modulate pain signals. The athletes' development of tacit pain perception demonstrates how central control processes can effectively "close the gate" on certain pain signals during ultra-endurance activities. When athletes learned to differentiate between pain types and contextualise their meanings, they were essentially utilising the gate control mechanisms to manage which pain signals received attention and which were inhibited.

The three specialised systems in pain processing (i.e., sensory-discriminative, motivational-affective, and cognitive-evaluative components) appeared to guide the learning and development of pain perceptual awareness. The active processing of these dimensions for different types of pain during environmental challenges helped to contextualise a more naturalistic understanding of the specialised systems beyond previous laboratory-based studies of pain perception and tolerance (Astorki & Mauger, 2016, 2017; Boat et al., 2021; Freund et al., 2013; Schutz et al., 2012). The naturalistic settings of Study 3 demonstrated this cyclical learning in action across different countries and locations, with varied terrain and weather conditions. These environmental factors significantly influenced how pain and discomfort were perceived by the athletes. For example, in freezing conditions, one recreational cyclist's Raynaud's syndrome was exacerbated in her hands while attempting to grip the brakes during mountain descents. Though she understood this pain would pass, she regretted not wearing appropriate gloves to mitigate the temporary but intense pain. Similarly, a professional triathlete experienced compromised performance due to freezing conditions affecting her feet and hands, until support crew intervention with hand warmers

improved her muscle control. These contextual examples illustrate how the processing of pain through the three specialised systems is dynamically influenced by environmental factors in ways that laboratory studies cannot fully capture. The learning from these pain experiences enabled the athletes to reflect on how to plan and implement changes for next time, demonstrating the self-regulatory cycle (Zimmerman, 2001).

The longitudinal cognitive thought processes of making sense of the sensory and affective perceptions of pain provided a greater understanding of the interplay between athletes' self-processes and social agents/environment in the practice setting (McCardle et al., 2019). Study 2 contributed to this understanding through its 64-week longitudinal monitoring approach. All three professional athletes developed overuse injuries despite different personalities, career stages, and support systems—suggesting ideological-level forces (Karos et al., 2024) operating beyond individual factors. At this ideological level, the sport ethic (Hughes & Coakley, 1991) and performance narrative (Carless & Douglas, 2013) functioned as cultural imperatives that transcended individual circumstances, creating shared expectations about legitimate pain responses and acceptable risk-taking within professional triathlon culture. These cultural forces shaped what counted as 'normal' training behaviour and 'acceptable' pain tolerance, making overconformity appear not as individual failure but as professional necessity.

By monitoring sensory and affective descriptors, pain intensity, and detailed qualitative reflections from the reflective journals, the study elucidated how different biopsychosocial factors influenced fluctuations in pain experience and tolerance levels. This pattern was evident in both race day and training pain experiences, revealing how injury, overtraining fatigue and competitive pressure contributed to an identity-based element in their pain experiences connected to their athletic identities (Lev, 2020). This finding resonated with Hall et al.'s (2022) meta-synthesis of injured endurance runners whose

running becomes a habituated action, with pain perception involving significant meaning-making that is contextually situated and socially influenced.

The importance of mental wellbeing underpinned the motivation to endure the ultra-endurance pain (Bean & Wimbs, 2021; Johansen et al., 2023). Nevertheless, there was a fine line between self-harm and self-preservation when perceiving pain during the self-monitoring performance phase of self-regulation. Pain perception was often reframed as discomfort alongside high tolerance levels which resonated with other athletes, albeit all elite runners (Bolling et al., 2019). This self-regulatory cycle involved becoming familiar with sensations and developing confidence in one's ability to tolerate them based on memories of their severity and temporary nature. As a result, these sensations were recategorised as discomfort, especially when compared back to other types of pain previously experienced.

Although not measured, some athletes showed signs of exercise dependence, according to Hausenblas and Symons Downs (2002) criteria (i.e., withdrawal, continuance, and tolerance), which appeared to have an influence on their mental wellbeing and motivation to push through pain and discomfort. The reliance on exercise to satisfy their wellbeing needs was an underlying influence on the denial or ignoring injury-related pain. More specifically, the behaviour of disregarding the sensory-discriminative feeling and tacit bodily awareness that something felt more serious, eventually led to overuse injuries and stress fractures, and.in one extreme case a near-death experience. These observations resonate with Gross's (2021) findings about exercise dependence, adding new insights about how this dependence influences pain interpretation and pain management. Some athletes demonstrated a pattern where psychological wellbeing relied on maintaining training volume, particularly in their ultra-sports as this tended to produce the desired wellbeing effect, sometimes at the expense of physical recovery. As excessive exercise has serious detrimental physical and

psychological consequences (Hall et al., 2007) it is important to carefully consider the athlete backgrounds to identify appropriate support where necessary (Schuler et al., 2018).

Additionally, the sport ethic (Hughes & Coakley, 1991; Coakley, 2015) operated across all three studies where collectively held norms created extreme pain tolerance and systematic pressures shaping individual pain interpretation and management. Bursik et al. (2025) extends understanding of how athletes manage physical health risks throughout their careers, demonstrating that risk management strategies exist on a spectrum from passive (externalising risks and refraining from proactivity) to active (calculated risk-taking to achieve success). The findings across this thesis align with Bursik et al.'s identification of "fluctuating prioritisation of health or success," wherein athletes demonstrated varying risk management strategies based on situational pressures such as competitive importance, injury severity, and recovery status. This pattern was particularly evident in Study 2, where professional identity pressures led to gradual erosion of self-protective boundaries—what Bursik et al. termed the development of overconformity not as sudden events but as temporal processes occurring across careers.

In summary, the risk factors that could hinder the athletes' ability to self-monitor for injury-related pain information were related to professional identity and links between mental wellbeing and exercise dependence. The interplay between professional identity and pain management can be understood through what Bursik et al. (2025) conceptualised as "relinquishing control under medical uncertainty." Across the three studies, athletes frequently demonstrated reliance on formal diagnoses to legitimise symptoms before acting, particularly evident in Study 2 where professional athletes often ignored pain until medical professionals validated their concerns. This finding aligns with Bursik et al.'s application of the Relational Theory of Risk (Boholm & Corvellec, 2011), which posits that risk perception emerges when individuals establish relationships between risk objects (such as pain) and

objects at risk (such as health or career progression). For the female ultra-endurance athletes in this research, pain became a risk only when it threatened valued outcomes—which shifted dynamically between performance goals and health preservation depending on career stage, competitive context, and injury experiences. The dynamic learning process of developing a tacit bodily awareness provides the foundation for athletes' success in tolerating all types of pain in their ultra-endurance sports. The next section examines how these athletes specifically learned from their varied pain experiences and developed effective coping strategies through experiential learning processes.

### 6.2.2 Learning from experience

The female athletes' ultra-endurance experiential learning of pain experiences was multidimensional and subjective to their sport and timeline of experience. This temporal approach across multiple ultra-endurance disciplines builds upon what Thuany et al. (2023) describe as temporal dimensions of athletic development: microtime (immediate sensations and responses during an event), mesotime (patterns developing across training cycles and competitive seasons), and macrotime (career-spanning changes and adaptations). The cyclical process of learning from their varied pain experiences was constantly updated and re-evaluated, especially when new sensations were noted and compared to previous experiences. For example, Study 1 (Chapter 3) showed retrospective sense-making with one athlete recounting: "From swimming through so much pain...everything passes, it's like a fluid flowing thing". In Study 2 (Chapter 4), a professional ultra-triathlete demonstrated the benefits of hindsight and learning from her rookie overtraining mistakes: "I need to learn to listen to my body more...rather than pushing through", as she reflected on why she had picked up a stress reaction injury early in the season. Moreover, Study 3's (Chapter 5) real-time think-aloud data captured immediate learning during events. One cyclist, for example, noted how differently she perceived and coped with pain over two consecutive days when affected

by emotions and anxiety about navigation and lack of family support. The temporal analysis demonstrated how female athletes displayed learning and reviewing within all phases of self-regulation.

Athletes transferred their experiential learning to preparation and coping strategies for future events. The athletes learned from practising pain management in training and from race experiences, reflecting on different pain causes and developing strategies to reduce pain in future sessions and competitions. This process of experiential learning and strategy refinement is supported by empirical evidence from Shipherd et al. (2021), who found that runners' across various experience levels and race distances (including ultramarathons), developed their ability to interpret and respond to pain signals evolved through accumulated competitive experience across three time points. This heightened bodily pain awareness (Allen-Collinson, 2023) assisted in perception and management through their preparation to cope with expected pain. The temporal approach to understanding experiential learning in this thesis extends Bursik et al.'s (2025) biographical mapping methodology by demonstrating how pain management strategies evolve not only retrospectively but also prospectively through systematic monitoring and real-time adaptation. While Bursik et al. captured athletes' retrospective constructions of risk management across their careers in handball, the current research integrates retrospective sense-making (Study 1), prospective weekly monitoring (Study 2), and concurrent real-time adaptation (Study 3) across multiple ultra-endurance disciplines. This multi-phase approach revealed the dynamic processes through which athletes construct and reconstruct their pain perceptions—showing learning as continuous and context-dependent rather than as discrete events stored in memory.

However, what athletes learn from experience is fundamentally shaped by sociocultural forces defining which pain-related knowledge becomes valued within ultra-endurance communities. The sport ethic (Hughes & Coakley, 1991; Coakley, 2015) creates

cultural frameworks wherein extreme pain tolerance demonstrates commitment and legitimacy, while prioritising recovery signals weakness. Across the three studies, female athletes learned not only biological pain differentiation skills and psychological coping strategies but also sociocultural norms about which pain responses constituted acceptable athletic behaviour. This cultural dimension of learning explains why athletes with different personalities, backgrounds, and support systems developed similar tendencies toward dangerous overconformity, suggesting ideological-level forces operating beyond individual differences.

The preparation for some included gastrointestinal pain strategy planning which involved having a consultation with a nutritionist for specific advice on which foods to eat and drink during events to alleviate the pain. For two athletes expecting the gastro pain, they also shared their strategies with crew support to ensure this was implemented, whereas others needed to be self-supported during gastro pain coping. Some athletes spent hours planning music playlists and/or downloading podcasts to listen to as an active distraction technique to expected pain. One athlete had used cold water immersion training to desensitise her perceptions and fear of the cold in the swim discipline of triathlon. Some practical adjustments were made to alleviate the chafing, rubbing, and blister related pain, such as equipment and clothing choices (e.g., cycling shorts, trainers, overshoes), product use (e.g., chamois cream, kinesio tape). Two athletes had devised goal adjustment plans in preparation for if the pain became too much for them to achieve their A-type goals. The professional athletes had previously practiced mantras and disruption techniques with their sport psychologists to help them cope with the expected pain. The findings highlighted how female ultra-athletes integrated knowledge from these sources into their personal planning for pain experiences to develop more practised pain management approaches. This displayed effective problem-solving skills, especially for the athlete-mothers with family responsibilities who

developed solution-focused mindsets and adaptability, which directly transferred to pain management in ultra-endurance contexts (Bean & Wimbs, 2021; Johansen et al., 2023).

Whereas Brick et al. (2015) established the importance of metacognitive strategies in endurance performance, the combined temporal findings demonstrate how this framework applies to female ultra-athletes by showing how they developed metacognitive strategies across different sports and adapted to the environment at the time (e.g., different countries, terrain, weather conditions). Study 2 and 3 particularly demonstrated learning during the performance and self-reflection phases to inform more effective differentiation between pain types for future training sessions or races. In Study 3, two different athletes employed attention redirection strategies, choosing not to focus on their pain to change negative thoughts and manage discomfort. This mirrors Salwin and Zajać's (2016) finding that female athletes tend to use dissociative strategies more often than men when managing pain, preferring to distract themselves by focusing on external factors rather than the pain itself.

The implementation of these strategies varied based on individual preferences and contextual factors. For instance, the longitudinal tracking of one of the professional triathletes in Study 2 showed how tolerance fluctuated based not merely on physiological state but on whether pain aligned with or threatened performance narrative maintenance (Douglas & Carless, 2009). Enduring pain was linked to how much they wanted to absorb the pain in their race, illuminating that if the willingness to hurt was not there, their usual coping strategies could not help them be faster or win a race. The rookie athlete did not adhere to her sport ethic and performance narrative of training through pain to get better and win when there no races during Lockdown. Similarly, Study 3's think-aloud verbalisations captured the rapid decision-making process on which pain coping strategies were best suited to the bodily sensations while actively self-monitoring the body in harsh environmental conditions. Gastrointestinal pain was a big challenge for four of the think-aloud athletes and each had

their own tried and tested remedy to help them cope with it, such as eating ginger or drinking cola. These metacognitive processes and the self-regulatory performance process operated concurrently, across different temporal phases and in naturalistic ultra-endurance contexts.

The athletes' ability to make these rapid decisions about pain coping strategies can be explained through the lens of Gate Control Theory (Melzack & Casey, 1968). This theory suggests that pain signals can be modulated at the spinal cord level by a gating mechanism influenced by descending signals from the brain. The cognitive strategies employed by the athletes such as distraction through music, focusing on scenery, or engaging in conversation effectively "close the gate" on pain signals by activating descending inhibitory pathways. However, the effectiveness of these cognitive strategies was influenced by biopsychosocial factors, including emotional state, anxiety levels, and environmental conditions. When the cyclist was anxious about navigation and lacked family support, the psychological strain appeared to "open the gate," allowing greater perception of pain signals despite using similar physical coping strategies. This demonstrates how Gate Control Theory provides a biological mechanism that connects psychological states to physical pain perception in a dynamic, context-dependent manner.

The integration of findings emphasised the use of developed active self-regulatory and distraction strategies that aligned with previous elite runners, to help the athletes during their pain experiences during training or competition (Brick et al., 2015). The thesis findings demonstrated that effective pain management involved practised self-regulatory strategies (planning, monitoring and reflecting: Zimmerman, 2001) such as chunking distance and time (breaking down the challenge into manageable segments); internal sensory monitoring (actively tracking their bodily sensations for duration and intensity); and using mantras and self-talk (positive, motivational, and instructional). Strategies were employed through an internal process of dynamic cognitive appraisals of the perceptual pain differences and

learning from previous pain experiences. Consequently, athletes decided on which strategy could be best utilised for the environment or ameliorate the pain and the biopsychosocial-environmental influences at that specific time in location, terrain, or weather.

The experiential learning shown by the athletes in Studies 2 and 3 extended the retrospective results of Study 1 by demonstrating the dynamic processes that the athletes would have gone through to develop their tacit awareness. In turn, the similar retrospective research findings on other ultra-athletes are also extended highlighting several psychological strategies to prepare for coping with the expected exercise induced pain (Bolling et al., 2019; Brick et al., 2015; Lasnier & Durand, 2022). The longitudinal reflective journaling in Study 2 evidenced its efficacy of serving as a tool to both a learning process and method for enhancing qualitative understanding of pain experiences which concurred with similar conclusions (Vicary et al., 2017). Through systematic journaling, athletes can identify patterns in how pain manifests under different conditions (e.g., terrain, weather, nutrition, menstrual cycle phases), developing deeper self-awareness that helps distinguish between productive discomfort and injurious pain. Journaling can also help athletes reflect on any unhelpful behaviours and emotions during injury periods or significant life events. While this experiential learning was largely self-directed, the findings also highlighted the crucial role that support systems played in enhancing athletes' pain management capabilities, as discussed in the following section.

### 6.2.3 Role of Support Systems

Beyond learning from experience, the crucial role of integrated support systems in effective pain management across all temporal dimensions was highlighted. This aligns with Thuany et al.'s (2023) ecological systems framework which conceptualises athletic performance through three hierarchical levels: the micro-level (individual characteristics, coach-athlete relationships), the meso-level (training facilities, competition opportunities),

and the macro-level (cultural contexts, economic conditions).in several key dimensions. Thuany et al. (2023) suggest that truly effective support systems must be holistic rather than fragmented, addressing needs at all ecological levels and accounting for how these levels interact with each other over time. The role of support systems highlighted by the findings in studies 1, 2, and 3 demonstrates how access to and utilisation of these support levels vary not only by sport discipline but also by competitive status, with elite athletes typically having more comprehensive access to formalised support networks than recreational participants. Furthermore, the findings reveal unique patterns in how female ultra-endurance athletes navigate these ecological systems, particularly when balancing athletic pursuits with other life roles. The thesis findings thus contribute to a more holistic understanding of how support systems function within a biopsychosocial framework of pain management, highlighting the dynamic interplay between athletic performance and environmental contexts across multiple levels of competition and various ultra-endurance disciplines.

The thesis findings indicated distinct categories of support that influenced female ultra-endurance athletes' pain management processes in fundamentally different ways. Medical and professional support, provided by healthcare practitioners, physiotherapists, and sports medicine specialists, offered clinical interventions and evidence-based pain management strategies but this support was often accessed differently depending on athletes' competitive level and previous healthcare experiences. Technical support, delivered primarily through coaches and training specialists, helped athletes develop physical preparation and race-specific strategies for pain management, though its effectiveness depended greatly on the coach-athlete relationship quality. Social and emotional support from family, friends, and fellow athletes influenced pain perception through psychological mechanisms such as distraction, motivation, and emotional regulation. Finally, logistical and practical support, particularly from dedicated race crews, addressed immediate physical needs during

competition that directly impacted pain experiences. Recognising these distinct support categories helps illuminate how athletes navigated complex support networks and why certain support mechanisms proved more effective than others in specific contexts.

The individual differences in support needs were illustrated in Study 3 (chapter 5), where two ultra-events necessitated race-specific support crew prerequisite for participation. This requirement highlighted how clear communication and thorough understanding of the individual athlete's needs became crucial for managing both sporting and environmental risks or hazards. The support crew needed to be reactive to the athlete's monitoring needs, including biological needs (adapting to weather temperatures/hydration/nutrition timing), psychological needs (understanding their mood and emotions), and social needs (moral support in challenging moments). This access to a race-specific support crew contrasted with other athletes in the research who were largely self-supported during their events.

These findings extend beyond merely applying Thuany et al.'s (2023) framework, rather, they deepen the understanding of how support systems function differently across competitive contexts and event structures. The observed specific role of crew support extends McCardle et al.'s (2019) work on self-regulatory processes by demonstrating how support networks inform each distinct phase of self-regulation. In the forethought phase, crews helped athletes prepare pain coping strategies and set expectations. During the performance phase, they implemented these strategies through practical interventions such as nutrition for relieving or preventing gastrointestinal pain issues or a sports massage for muscular pain and discomfort. Finally, in the self-reflection phase, crews provided valuable external perspectives that help athletes evaluate their pain experiences and coping strategies, to facilitate improvements for their next events. This comprehensive integration of support across all phases was iterative for both crew and athlete during each event and aligns with an ecological systems perspective (Thuany et al., 2023) which acknowledges how these multi-

layered support interactions become embedded within the athlete's broader environmental context.

The importance of social support is further reinforced by research on social dimensions of pain in athletic contexts. This interpersonal dimension of support extended beyond practical assistance to influence pain perception itself. Bluhm and Ravn (2022) found that elite runners' pain experiences were not described as purely private incidents, but also as intersubjectively shaped interactions. Bluhm and Ravn's (2022) research documented how the presence of training partners positively influenced their pain perception when running together with a fellow runner. This phenomenon can be understood through Gate Control Theory (Melzack & Casey, 1968), which proposes that cognitive and emotional inputs can modulate pain signals at the spinal cord level. Social interactions appear to activate the central control processes that "close the gate" on pain signals. Conversely, negative social experiences, such as feeling judged for athletic pursuits while managing family responsibilities, may "open the gate," intensifying pain perception. The gate control mechanism thus provides a neurophysiological explanation for how social support directly influences the biological processing of pain signals, beyond just providing distraction or emotional comfort. This intersubjective shaping of pain experiences was evident in this thesis, where athletes described similar experiences of a training partner could help them push the pain barriers, or be an active distraction with banter and chatting. However, for some athletes being alone was preferred for internalising pain and not needing to speak or think about pain.

The female athletes' self-regulatory capabilities were enhanced or constrained by their access to comprehensive support, particularly highlighting the unique societal influence on females as athlete-mothers. This resonates with similar findings in marathon runners (Bean & Wimbs, 2021; Johansen et al., 2023) that social support was essential for helping them

manage both their training schedules and the psychological pressures of balancing athletic and maternal identities. For example, in Study 3 (Chapter 5), one athlete experienced a complete lack of adequate partner support at home and felt societal pressures amongst extended family or friends which led to the mom guilt being transferred into affecting her pain tolerance levels during day 1 of her event. Navigating dual identities i.e., being simultaneously athletes and women, demonstrated how pain management context included not only sporting demands (Krane et al., 2004), but also gendered social expectations that male athletes typically do not encounter (Allen-Collinson & Jackman (2022). A similar guilt was displayed in Study 1 (Chapter 3) for an age-group ultra-triathlete-mother of two young children who felt the societal pressure from friends and family to devote so much time to training and racing. From a cross-cultural perspective, this resonated with findings from Johansen et al. (2023) who particularly noted that Norwegian female endurance athletes, despite living in a country known for gender equality, still faced gendered constraints and expectations around childcare, requiring them to develop strategic approaches to manage these pressures while maintaining their athletic pursuits.

From a longitudinal perspective, professional career pressures led to potentially harmful pain management decisions, resulting in overuse injuries during high-pressure race periods and a tendency to push through warning signals when career stakes were high. Such findings illustrate and extend what Thuany et al. (2023) describe as the influence of meso-level factors (such as training facilities, financial support, and competitive structures) across multiple ultra-endurance sports. The research showed how competitive environments and professional status created pressures that directly impacted athletes' decision-making about their bodies, regardless of their specific discipline. The overuse injuries evidenced insufficient recovery periods due to competitive demands. Notably, the coach was a pivotal figure in balancing training and competitive pressures; insufficient support led two

professional athletes to change coaches, while the self-coached athlete developed alternative support systems, including medical practitioners and spousal support.

Attempting to manage pain entirely independently often proved detrimental. In Study 1, this was particularly evident when some athletes experienced guilt about seeking treatment and perceived needing support as a sign of weakness, findings that resonated with runners who described power imbalances in their relationships with physiotherapists and sought to alienate themselves from their injuries (Lev, 2020, 2021). Many athletes have reported hesitancy in seeking medical support due to previous experiences of having their pain experiences minimised or dismissed, a finding that aligns with broader research on gender disparities in pain treatment (Hainline et al., 2017). However, this was not the case for any of the athletes in this thesis, in fact the professional ultra-triathletes embraced the medical support probably as their body was viewed as their work tool which needed to be maintained.

The role of medical practitioners in shaping athletes' pain management may become a conflict of interest (Bursik et al., 2025) when they are embedded within performance-focused organisations. While this thesis focused primarily on individual athletes' experiences rather than organisational structures, Study 2 revealed how medical uncertainty influenced professional triathletes' decision-making about training and competing with pain. Bursik et al. recommended implementing policies ensuring medical staff independence, such as mandating financial disclosure and removing performance-related incentives—recommendations that warrant consideration in ultra-endurance contexts where athletes increasingly compete as professionals. Furthermore, Paul et al.'s (2022) observations about power imbalances in shared decision-making contexts suggest that female ultra-endurance athletes may be particularly vulnerable when expected to assess complex health information while navigating performance pressures and gendered medical interactions (Hainline et al., 2017).

Across the three key findings—development of tacit pain perception, learning from experience, and the role of support systems—a consistent pattern demonstrated female ultra-endurance athletes navigating complex biopsychosocial interactions to manage their pain experiences. The thesis contributes to a biopsychosocial understanding through the integration of previously separate frameworks. The Neuromatrix Theory (Melzack, 2001) and Gate Control Theory (Melzack & Casey, 1968) provide the biological foundation, explaining how pain signals are processed through sensory-discriminative, cognitive-evaluative, and motivational-affective dimensions. This biological understanding is complemented by Self-Regulation Theory (Zimmerman, 2001), which elucidates the temporal cyclical processes through which athletes monitor and reflect to adjust their pain coping responses. Further enhancing this integration, the Metacognitive Framework (Brick et al., 2015) illuminates the specific cognitive strategies employed during these self-regulatory processes, such as attention redirection and chunking distance techniques observed in Studies 2 and 3. This novel theoretical synthesis provides a more holistic and comprehensive understanding of which biopsychosocial factors influenced ultra-athletes, especially longitudinally and in real-time events. While these frameworks have previously been applied separately in endurance research, the thesis findings demonstrate how they interact dynamically in female ultra-endurance pain contexts to provide integrated biopsychosocial explanations that more accurately represent athletes lived experiences.

**6.3 Contribution to Knowledge**

Overall, by examining diverse female ultra-athletes, ranging from professional triathletes to recreational trail runners and cyclists, this research provides novel insights into a population that has been systematically overlooked, despite their increasing successful participation in ultra-endurance events. This thesis makes a significant methodological contribution through its innovative multi-phase mixed methods design that systematically

triangulates the ultra-athletes' pain experiences captured by using a variety of methods across distinct retrospective, longitudinal, and real-time temporal perspectives. The methodological progression across studies provided increasingly unique insights into the multidimensional and subjective nature of ultra-endurance pain experiences and coping responses, during a variety of ultra-sports. Specifically, Study 1's IPA approach illuminated how athletes made meaning of their accumulated embodied lived experiences to inform future pain evaluations and coping. Study 2's longitudinal mixed methods design captured how the individual professional identity, COVID-19 lockdown, and other associated biopsychosocial factors could influence the fluctuations of pain tolerance and interpretations across a competitive season. Lastly, Study 3's innovative field study implementation of adapting the think-aloud protocol accessed the immediate detailed pain experience thought processes previously hidden from researchers.

This progressive approach revealed aspects of ultra-endurance pain experience that would have remained invisible using any single methodology. Whereas previous researchers have typically employed either retrospective interviews (e.g., Antonini-Philippe et al., 2016), laboratory and field physiological measurements (e.g., Schutz et al., 2012), or shorter duration think-aloud protocols (Johnson et al., 2023; Samson et al., 2017; Whitehead et al., 2018, 2019), this research established the integration of multiple approaches into a coherent investigative framework, though it should be noted that physiological measurements were not included.

The methodological innovation is particularly evident in Study 3's implementation of think-aloud protocols during extreme ultra-endurance events across different sporting contexts. By capturing thought processes during two elite events (i.e., challenging Norseman X-Triathlon and a 24-hour track race) as well as multi-terrain (a 100-mile trail run), and multi-day (Everest cycling challenge in Pyrenees) events, Study 3 establishes the viability of

real-time data collection in conditions previously considered difficult for such research methods. Furthermore, the adaptation of the McGill Pain Questionnaire for field use during ultra-events bridges the gap between standardised pain assessment and ecological validity, though similar field adaptations may have been used in other contexts. This mixed method methodological approach creates a template for future researchers investigating complex psychological phenomena in naturalistic athletic settings while maintaining scientific rigour.

Moreover, the combination of qualitative and quantitative data collection methods across temporal perspectives provides a more comprehensive understanding of how pain experiences and coping strategies evolve. Female athletes' pain experiences were shaped by both immediate physiological demands and broader sociocultural influences, addressing McCardle et al.'s (2019) call for more ecologically valid investigations of athletes' self-regulatory processes. The three methodological gaps, namely, limited real-time data collection in ultra-events, lack of longitudinal tracking, and the need for more mixed method designs were all addressed through the multi-phase mixed method design. Combining the three distinct temporal dimensions resulted in a richer, holistic picture of how pain experiences and coping evolve in a variety of female athletes. The participant sampling design targeted population gaps by gathering data from current practising female ultra-athletes from a variety of nationalities and age groups, including competition levels from recreational to elite/professional. This provided ecological validity across different contexts, though it should be noted that aspects such as socioeconomic status, cultural background, and ethnicity were not explicitly examined in this research.

Beyond methodological innovations, this thesis makes theoretical contribution through its integration of phenomenological embodiment and sociological frameworks within biopsychosocial pain understanding. While previous ultra-endurance pain researchers have focused primarily on biological mechanisms (pain physiology, tolerance thresholds) and

individual psychological processes (cognitive strategies, self-regulation), the analysis of the findings of the studies demonstrated how sociocultural forces fundamentally shape pain experiences through mechanisms that cannot be reduced to individual factors. Building upon sociological research examining the "culture of risk" in elite sport (Nixon, 1993; Roderick et al., 2000; Theberge, 2008), the combined thesis findings extend understanding by demonstrating how these cultural forces operate specifically in female ultra-endurance contexts. Bursik et al.'s (2025) application of risk management theories to elite handball provides a complementary framework, though the current research advances this by capturing prospective longitudinal processes rather than retrospective constructions. These theoretical frameworks illuminate how cultural narratives shape pain experiences through mechanisms operating at multiple ecological levels simultaneously (Karos et al., 2024). Integrating sociological framework specifically sport ethic (Hughes & Coakley, 1991; Coakley, 2015) and performance narratives (Douglas & Carless, 2009, 2015), revealed how cultural forces systematically shape which pain experiences become normalised, valorised, or dismissed within ultra-endurance communities. This multi-dimensional integration creates comprehensive understanding of pain as simultaneously biological process, psychological interpretation, sociocultural practice, and phenomenological lived experience.

The empirical evidence of sport ethic influences (e.g., disregarding injury warnings to maintain training), performance narrative pressures (e.g., professional identity fundamentally shaping pain interpretation), and gendered embodiment challenges (e.g., mom guilt affecting pain tolerance) demonstrates that female ultra-athletes' pain experiences develop from complex negotiations between biological capabilities, psychological strategies, and sociocultural positioning. The integrated biopsychosocial approach addresses McCardle et al.'s (2019) call for more ecologically valid investigations that examine how social agents and environmental contexts interact with individual self-regulatory processes. The

biopsychosocial theoretical integration provides more comprehensive understanding of female ultra-athletes' pain experiences than approaches focusing on single dimensions.

## 6.4 Limitations

Although the thesis shows significant contributions to advance knowledge, it is customary to acknowledge the limitations, following a systematic critical reflective process.

### *6.4.1 Methodological limitations*

As noted in 6.3, a primary limitation stems from the absence of concurrent physiological measurements across Studies 2 and 3 due to the researcher's current skillset and defined scope of the research aims of the thesis. Although the research captured detailed psychological and behavioural data, the lack of physiological markers such as hormonal levels, inflammatory markers, and immune system indicators restricts the complete understanding of the biological component within the biopsychosocial framework. For example, this limitation particularly affects the understanding of how female-specific hormonal cycles influence pain experiences and management strategies. As Melzack and Katz (2012) emphasised, pain experiences involve multifaceted interactions between physiological and psychological processes. The absence of biological markers means it is not possible to fully document these biological interactions.

The think-aloud methodology in Study 3, although innovative, captures only verbalised thoughts and may miss non-verbal or subconscious processes involved in pain perception and management. Athletes may have been selective in what they verbalised, particularly during intense moments of discomfort, potentially leading to incomplete data about their thought processes, such as when internalising the pain and verbalising when they wanted to ignore the pain. Additionally, the act of verbalising thoughts may have altered the natural pain experience itself, creating a potential observer effect on the phenomena being studied. However, all athletes engaged well in the process considering the nature of their

events and usual pain coping strategies. An important ethical consideration emerged regarding research participation effects. Several participants noted that systematic reflection on pain experiences heightened their awareness of pain management strategies during subsequent competitions. While this represents valuable reflexive learning that participants found beneficial, it also constitutes an intervention effect that may have influenced later data collection phases and should be considered when interpreting longitudinal findings.

Although the purposeful sampling yielded a demographic homogenous sample, according to the inclusion of female ultra-endurance athletes from a variety of sports, the sample sizes potentially limit naturalistic generalisability for athletes discerning what is similar and different to their own situations (Smith, 2018) as they lacked detailed documentation of socioeconomic status, cultural background, and ethnicity variations, which add to further understanding the context of pain experience influences and coping responses through culturally mediated attitudes and access to resources (Robinson, 2014; Smith, 2018). These were not specified within the inclusion criteria but in further research this could be explored. Beyond these methodological considerations, the research also faced important contextual limitations that potentially influenced the data collection and findings.

### 6.4.2 Contextual limitations

The data collection period coincided with the COVID-19 pandemic, introducing unusual circumstances that may have influenced typical patterns of professional training regimens, competition schedules, and recovery protocols in Study 2. This external factor potentially affected both training patterns and competition experiences, making some findings less generalisable to normal competitive conditions. However, as noted by Hainline et al. (2017), understanding how athletes adapt to unusual circumstances can provide valuable insights into their resilience and adaptability. For example, research by Mon-López et al. (2020) examining COVID-19's impact on athletes found that the confinement period

significantly reduced training load across athletes and altered sleep patterns, including both sleep time and sleep quality. Importantly, Mon-López et al. (2020) reported that male and female athletes' moods were affected differently by confinement, with women's sleep quality showing a greater reduction (34.55%) compared to men (13.04%). Specific to this thesis, although there were similar pandemic-related disruptions regarding training consistency and recovery patterns, all three athletes continued to engage in the weekly monitoring of the study despite these unusual circumstances.

### 6.4.3 Conceptual and Theoretical Limitations

While this thesis employed an integrated biopsychosocial framework incorporating sociological perspectives, several conceptual limitations warrant acknowledgment. First, although the thesis findings have identified sport ethic influences and performance narrative patterns within participants' experiences, it did not systematically investigate the organisational and institutional structures that produce and maintain these cultural forces. Understanding how ultra-endurance event organisations, governing bodies, sponsorship structures, and media representations create systems that reward extreme pain tolerance represents an important direction for future research examining macro-level forces shaping individual athletes' pain experiences. Second, while the thesis documented gendered dimensions of pain experience (mom guilt, dual identities, societal pressures), the sampling did not enable systematic examination of how other social identities—including race, class, age, and sexuality—intersect with gender to create unique pain experiences. Third, the findings of this thesis highlight primarily how sociocultural forces influenced individual athletes' pain experiences, rather than examining collective resistance or transformation of harmful pain cultures within ultra-endurance communities. Future researchers could explore whether and how female ultra-athletes engage in collective meaning-making that resists

dominant pain cultures, potentially identifying pathways toward more sustainable sporting environments.

### 6.4.4 Research Participation Effects and Heightened Pain Awareness

An important methodological consideration concerns the effect of research participation on athletes' awareness and processing of pain experiences. Across Studies 2 and 3, several participants spontaneously reported systematic engagement with pain reflection and reporting heightened their metacognitive awareness of pain during subsequent ultra-endurance endeavours. This heightened awareness represents what Palmer (2016) describes as an unintended intervention effect—where research procedures designed to observe phenomena inadvertently alter the very processes under investigation. The nature and extent of this intervention effect differed between studies. In Study 2, the longitudinal design allowed heightened awareness to develop gradually over 64 weeks through remote, asynchronous weekly reflections. Conversely, Study 3's think-aloud protocol created more immediate and intensive metacognitive engagement during actual competition. From a methodological perspective, longitudinal findings from Study 2 may reflect not only naturally occurring developmental trajectories but also learning effects produced by repeated pain strategy reflections. Similarly, the think-aloud protocols in Study 3 may have elicited more metacognitively sophisticated pain processing than would occur without concurrent verbalisation requirements. However, these intervention effects do not necessarily invalidate the research findings. Rather, they highlight the participatory and co-constructed nature of knowledge production in qualitative and mixed-methods research (Palmer, 2016).

Many participants viewed this heightened awareness as beneficial, reporting improved self-regulatory capacity and more strategic pain management approaches. Suggesting that systematic reflection on pain may itself constitute a valuable cognitive training tool for ultra-endurance athletes, a finding with practical implications for coaching and sport psychology

practice. Future researchers could explicitly examine this intervention effect by incorporating control comparisons between athletes engaging in systematic pain reflection versus standard training conditions, carefully navigating ethical considerations regarding informed consent about potential awareness effects and the situational vulnerability of athletes experiencing extreme pain states.

## 6.5 Practical Implications

The research findings translate into practical applications that address gaps identified in supporting female ultra-endurance athletes through an integrated biopsychosocial approach. These applications build upon theoretical understanding developed through this thesis while responding to calls for more holistic and comprehensive interdisciplinary support systems (Hainline et al., 2017; Jackman et al., 2024a, b; Meijen et al., 2017). These applications address both immediate performance needs and long-term athlete wellbeing, though should be viewed considering the limitations previously discussed.

### 6.5.1 Developing comprehensive support systems

From the thesis findings, it is recommended that practitioners supporting female ultra-athletes adopt an interdisciplinary approach, with regular collaborative monitoring of overall wellbeing linked to athletes' pain experiences. Integrated assessment systems could address female-specific considerations such as hormonal fluctuations (identified in Study 1), professional competitive pressures influencing pain tolerance and overtraining (highlighted in Study 2). Also, the need for reactive support from crew during events and the importance of identifying suitable alternatives when partner/family support is limited (demonstrated in Study 3). As evidenced across all three studies, effective communication is required between the ultra-athlete and the significant others placed or held in a support position.

This interdisciplinary approach aligns with Thuany et al.'s (2023) ecological systems model, emphasising how athletes' experiences develop from interactions between individual

characteristics and environmental factors across multiple levels. While Thuany et al. (2023) developed their framework specifically for runners, this thesis extends their model by demonstrating how these ecological interactions influence female athletes across various ultra-endurance disciplines including triathlon, trail running, and cycling. The diversity of sports examined in naturalistic ultra-endurance settings reflected a broader ecological validity to these findings, showing how environmental contexts operate differently across sporting domains yet produce similar patterns in pain experiences. The model's temporal dimensions (microtime, mesotime, macrotime) parallel the temporal approach used in this research, offering a theoretical foundation for understanding how support systems need to operate across immediate event contexts, training cycles, and career-spanning developmental processes.

This recommendation, of having a support network to help monitor physical and mental wellbeing, aligns with the findings of Etxebarria et al. (2019) who purported that athlete health is the foundation for performance and that consistency in training is vital for success. Etxebarria et al.'s research emphasised that most high-performing athletes experience health issues during a season that slow training progress, making an integrated approach with effective communication between clinicians and coaches essential. The current research extends this by highlighting how such integrated approaches are particularly important for female ultra-endurance athletes navigating complex pain experiences.

Within this interdisciplinary framework, sport psychologists constitute a crucial component of the support system by tailoring interventions based on athletes' competitive level, accrued experience, and specific sporting needs. For developing athletes, focus on fundamental pain management skills, including both active self-regulatory strategies (e.g., internal sensory monitoring) and distraction techniques (e.g., chunking distance). For elite competitors, address the professional identity-pain relationship highlighted in Study 2,

helping athletes navigate career pressures while maintaining effective pain discrimination. In both cases, develop decision-making frameworks that integrate the temporal aspects of pain learning demonstrated across all three studies. Shipherd et al.'s (2021) findings that injury and pain contributed to lowered self-efficacy beliefs offer empirical support for developing a pain management approach with athletes, highlighting how psychological interventions addressing pain interpretation can positively influence athletes' confidence in their pain tolerance.

Several strategies arose from this research that sport psychologists are encouraged to consider implementing with athletes. First, developing a comprehensive monitoring system of weekly journals tracking biopsychosocial factors could help identify patterns in pain experiences (Saw et al., 2015; Vicary et al., 2017). Vicary et al. (2017) particularly noted how reflective journaling can enhance qualitative understanding of pain experiences, helping athletes recognise patterns in how pain manifests under different conditions and develop deeper self-awareness about pain signals. Developing individualised pain coping plans based on the athlete's experience and specific sport demands may also be beneficial. Sport psychologists could work with athletes to develop their communication with support personnel, addressing the finding that some athletes struggled to effectively communicate their pain experiences. Additionally, helping athletes develop balanced approaches to maintaining psychological wellbeing that do not rely exclusively on training volume could address the exercise dependence patterns observed in some participants. Lastly, it would be pertinent for psychologists to identify any early warning signs of dependence affecting ultra-athletes potentially dangerous pain-related decision-making (Schuler et al., 2018).

Beyond individual-level interventions, sport psychologists should attend to sociocultural forces maintaining harmful pain normalisation within ultra-endurance contexts. This includes helping athletes recognise sport ethic influences on pain management decisions—distinguishing between pain tolerance derived from individual goals versus

cultural conformity pressures. Psychologists can facilitate critical reflection on performance narratives by exploring whether athletes' identities depend entirely on sporting achievement or incorporate other valued life domains (relational, professional, creative), potentially building resilience against the narrative wreckage that can occur when injury or life circumstances prevent maintaining ultra-endurance participation. For female athletes specifically, addressing the dual identity challenges identified by Krane et al. (2004) requires validating both athletic and feminine aspects of identity while helping athletes navigate societal pressures that may position these identities as conflicting rather than complementary.

Sport psychologists working with ultra-endurance teams, clubs, or training groups could implement collective interventions addressing cultural pain norms. Acknowledging the time taken to achieve this to change norms, this might include facilitating longitudinal group discussions about sport ethic influences and performance narrative pressures, creating opportunities for athletes to examine how cultural forces shape individual pain management decisions. Developing alternative community narratives that value long-term athlete development, sustainable training practices, and holistic wellbeing alongside competitive achievement could reduce conformity pressures toward harmful pain tolerance. For female-specific groups, creating spaces where women can discuss gendered challenges (mom guilt, medical dismissal, dual identity navigation) without judgment may reduce isolation and provide collective resources for managing these distinctive pressures. Mental skills training must address sensory transformation, facilitate embodied knowing, recognise gendered constraints, support pain acceptance, and help to cultivate kinaesthetic awareness (Hanold, 2010; Throsby, 2013).

Addressing positive deviance and overconformity requires not only educating athletes about self-regulation but also transforming the cultural narratives that valorise dangerous levels of commitment (Bursik et al., 2025; Hughes & Coakley, 1991). Governing bodies,

event organisers, media, and sponsors all play roles in either reinforcing or challenging these narratives. Creating space for alternative narratives—such as the "relational" and "discovery" narratives identified by Douglas and Carless (2006)—could provide athletes with identity resources that do not depend solely on performance outcomes. This might involve highlighting athletes who maintain multidimensional identities, celebrating sustainable training practices alongside competitive achievements, and critically examining language that equates pain tolerance with moral virtue. Such cultural interventions could complement individual-level support by reducing the social pressures that drive positive deviance while validating diverse pathways to athletic fulfilment beyond extreme pain tolerance.

Medical practitioners represent another critical component of the interdisciplinary support team and require specific guidance based on these research findings. They may benefit from understanding how ultra-endurance athletes accrued experience influenced pain reporting and interpretation, as the research demonstrated that high pain tolerance could sometimes mask serious issues when downgraded to discomfort from pain. Aligning with Shipherd et al.'s (2021) findings, medical staff should employ multiple assessment approaches when evaluating pain in female ultra-endurance athletes, recognising that standardised pain scales may not capture the tacit interpretations that experienced athletes develop through years of competition. For example, working with novice athletes, medical practitioners could educate the athletes about different types of pain and their significance if ignored. Whereas with more experienced athletes, practitioners should tune in and consider the athlete's extensive knowledge of their body and high pain tolerance levels to gain more detailed understanding of the athlete's pain issues. Considering the psychosocial influences on athletes' perceptions of pain and tolerance levels is also crucial during pain diagnosis and treatment planning (Alaiti & Reis, 2022; Hainline et al., 2017) to ensure overall wellbeing. Indeed, Alaiti and Reis (2022) emphasised that modern pain science has evolved from a

Cartesian model (pain = tissue damage) to a multidimensional perspective whereby factors such as tissue overload, nociceptive gain, and cognitive, emotional, behavioural, and lifestyle factors interact to influence pain experiences. Their research highlights the importance of implementing patient-reported outcome measures and developing sport-specific assessment instruments that acknowledge this complexity.

Coaches are encouraged to adopt an athlete-centred approach to pain management based on the athlete's experience level while maintaining focus on long-term development. If this requires continued professional development training, then this could be implemented (see 6.5.2 for details). With novice athletes, creating structured environments for developing pain management capabilities could be beneficial. Coaches might deliberately expose athletes to different types of training-related pain while teaching appropriate monitoring and management strategies. With elite athletes, implementing periodisation that considers both physical and psychological aspects of pain management appears important, as Study 2 showed professional athletes require careful balancing of training demands with recovery needs (Bolling et al., 2019). Creating training environments that validate athletes' psychological wellbeing needs for competence, autonomy, and relatedness while maintaining appropriate physical boundaries is important (Schuler et al., 2018). This includes helping athletes develop alternative strategies for maintaining mental wellbeing during recovery periods (Meussen et al., 2013). The consensus statement on recovery and performance by Kellmann et al. (2018) supports this approach, emphasising that recovery is not merely the absence of training but an active process requiring individualised approaches. Kallus & Kellmann's (2016) "scissors model" illustrates how increased training stress must be matched with increased recovery efforts, with systematic monitoring helping to detect early signs of overreaching and prevent progression to overtraining syndrome.

For athletes using ultra-endurance sports as part of their mental health management, practitioners are encouraged to establish comprehensive support systems that include liaising with mental health specialists. These might include sport psychologists with specific expertise in clinical disorders, clinical psychologists or psychiatrists who understand athletic contexts, and counsellors experienced in working with athletes. This recommendation is supported by Schaal et al.'s (2011) epidemiological study, which found that female athletes (20.2%) had higher rates of psychological disorders compared to male athletes (15.1%), with notable gender differences in anxiety disorders, eating disorders, depression, sleep problems, and self-harming behaviours. Schaal et al.'s research concurs with this thesis that female ultra-endurance athletes may require specialised mental health support that addresses these gender-specific psychological challenges.

### 6.5.2 Policy implications

Several broader implications for policy can be identified, though these should be implemented with awareness of the limitations previously discussed. Given the unique considerations for female ultra-endurance athletes, governing bodies for ultra-endurance sports could consider developing gender-sensitive pain management guidelines. These guidelines might recognise the biological factors (such as hormonal fluctuations), psychological factors (including exercise dependency), and social factors (particularly maternal role conflicts) as influencing female athletes' pain experiences and provide a framework of recommendations for race organisers, medical teams, and coaches. For example, medical support protocols could acknowledge potential gender differences in pain reporting and interpretation based on the findings of this thesis. Organisations such as the International Association of Ultrarunners (IAU), the International Triathlon Union (ITU), and national governing bodies for endurance sports could integrate these gender-sensitive

approaches into existing athlete welfare policies, particularly for events where environmental extremes increase pain management challenges.

Academic and professional education programmes for sports medicine, coaching, and sport psychology could incorporate the biopsychosocial understanding of female ultra-athletes' pain experiences. This might include developing specialised modules on female-specific pain considerations in coaching certification programmes, integrating case studies from this thesis for educational purposes, and creating interdisciplinary training scenarios based on real-world examples from the thesis.

National governing bodies might consider implementing revised athlete development frameworks that integrate systematic pain management education at each development stage. These pathways could introduce developmentally appropriate pain education for young female athletes, implement progressive pain management training for developing athletes, and establish mentorship programmes that connect experienced female ultra-athletes with developing competitors to share embodied knowledge about pain management.

**6.6 Future Research Directions**

Building on both the findings and limitations of this research, several key areas warrant further investigation using an integrated biopsychosocial mixed method research approach. These research directions aim to deepen understanding of female ultra-endurance athletes' pain experiences while addressing methodological gaps identified in the current thesis.

*6.6.1 Integrating biological factors*

To address a key limitation of this thesis, future researchers could investigate the relationship between hormonal fluctuations and pain perception in female ultra-endurance athletes through longitudinal designs tracking both physiological markers and pain experiences across multiple cycles and training phases. This builds on Melzack's (2001)

Neuromatrix Theory by examining how female-specific physiological variations influence pain processing. Studies examining the relationship between inflammatory markers, immune system function, and pain experiences during ultra-endurance events could help identify biological thresholds for safe pain tolerance and improve recovery protocols for female athletes, addressing gaps identified by Hainline et al. (2017) in understanding female-specific pain responses. These investigations would provide critical data on physiological aspects of pain that were not captured in the current research. Such studies would, however, require significant resources and participant commitment, necessitating careful consideration of the research design to maximise benefits while minimising participant burden.

Boukelia et al. (2018) found that time of day affects physiological and immunological responses to endurance exercise in hot, humid conditions, with differences in core body temperature, white blood cell counts, and heart rate responses between morning and evening exercise. Future researchers could expand on this to examine how these diurnal variations might interact with female-specific hormonal fluctuations to influence pain perception and tolerance during ultra-endurance events. Investigation of how psychological stress, physiological stress markers, and pain perception interact in female ultra-athletes, particularly during high-pressure competitive periods, would extend McCardle et al.'s (2019) work on self-regulatory processes in sport.

### 6.6.2 Longitudinal career development

Extended longitudinal studies could examine how pain management strategies develop throughout female athletes' careers, addressing temporal limitations identified in the current research. This might involve tracking pain perception and management strategies from early career through to elite level performance, building on Stambulova's (2016) career transition model while incorporating pain management considerations. This could also include examining how early pain experiences and management approaches influence long-

term athletic development and career longevity in female ultra-endurance athletes, extending Jackman et al.'s (2024a, b) work on goal striving in ultra-endurance contexts.

Ronkainen et al.'s (2013) research on aging and career continuity in endurance sports identified four major storylines about how athletes experience aging and performance decline. Future researchers could explore how female ultra-endurance athletes specifically navigate these career transitions, particularly focusing on how their relationship to pain changes throughout their career development. Ronkainen's finding that athletes with multidimensional identities (where winning was not the only motive) maintained longer careers suggests that how female athletes construct meaning around their sporting identity significantly influences how the athletes experience and cope with physical challenges.

### 6.6.3 Sociocultural influences and support networks

Assessing the role of support networks in developing effective pain management approaches would be valuable, particularly considering gender dynamics within these networks and addressing findings from the current study about the importance of comprehensive support systems. Such research could draw upon ecological systems theory to better understand how multiple levels of social context influence pain experiences. Bean and Wimbs (2021) found significant variation in partner support for mother-athletes, ranging from complete support to active resistance. Future researchers could explore how these varying levels of social support influence female ultra-endurance athletes' pain tolerance and management. Additionally, investigating how organisational and structural factors create and maintain pain cultures within ultra-endurance sports, extending Bursik et al.'s (2025) findings from team sports to individual ultra-endurance contexts. This includes examining how event organisations, governing bodies, sponsorship structures, and media representations systematically reward extreme pain tolerance while inadvertently discouraging appropriate pain management and injury prevention. Building on recent researchers who demonstrated

how conformity to the sport ethic facilitates psychological maltreatment (McGee et al., 2024), future researchers could identify whether and how female ultra-athletes engage in collective meaning-making that resists dominant pain cultures. Such as exploring pathways toward more sustainable sporting environments that do not require dangerous pain tolerance for community belonging or athletic recognition. Furthermore, applying risk management frameworks (Boholm & Corvellec, 2011; Huber, 2012) specifically to female ultra-endurance contexts could illuminate how athletes at different competitive levels and career stages construct and manage pain-related risks, potentially revealing gender-specific patterns in risk perception and evaluation.

Building on Thuany et al.'s (2023) ecological systems framework, future researchers could investigate how broader sociocultural factors (macro-level) interact with immediate support environments (meso-level) to influence female ultra-endurance athletes' pain experiences across different cultural contexts and sporting disciplines. Their model, which was developed specifically for runners, could be extended to examine how environmental factors operate differently across ultra-endurance sports while producing similar patterns in pain experiences. Additionally, studies exploring how these ecological systems evolve over time (microtime, mesotime, macrotime) could provide insight into developmental pathways for pain management capabilities across an athlete's career.

### 6.6.4 Methodological considerations

Future researchers could also advance methodological approaches for studying pain experiences in ultra-endurance contexts. This includes developing more robust methods for capturing real-time pain experiences during events, building on recent recommendations for think-aloud protocol implementation in challenging conditions. Developing mixed method approaches that effectively integrate physiological measurements with psychological assessments would address a key limitation of the current research. Future methodological

researchers could develop and validate ultra-endurance-specific pain assessment tools that balance comprehensive assessment with practical field implementation. Additionally, brief instruments focused on psychological factors like those used by Slepian et al. (2020), the Brief Resilience Scale (BRS) and Pain Self-Efficacy Questionnaire 2 (PSEQ-2), could be adapted specifically for ultra-endurance contexts to provide valuable information about how pain affects function.

Collectively, these research directions build upon the theoretical, methodological, and practical contributions of this thesis while addressing its identified limitations. By integrating biological, psychological, and social approaches across temporal dimensions, future researchers can develop a more comprehensive understanding of female ultra-endurance athletes' pain experiences. This integrated approach has the potential to advance both theoretical understanding and practical support for this growing population of athletes who continue to push the boundaries of human endurance.

## 6.7 Conclusions

This thesis advances understanding of female ultra-endurance athletes' pain experiences through its innovative integration of multiple temporal perspectives and mixed methods approaches. Examining pain experiences retrospectively, longitudinally, and in real-time, elucidated how female athletes develop tacit pain differentiation abilities, how these abilities fluctuate under different biopsychosocial conditions, and how athletes implement them during competition. The research makes an original contribution through its theoretical integration of Neuromatrix Theory, Gate Control Theory, Self-regulation, and Metacognitive Frameworks, the Sport ethic, and Performance Narrative while its methodological innovation of implementing think-aloud protocols during ultra-events offers unprecedented access to athletes' real-time cognitive processes. Findings addressed critical gaps in existing literature by integrating biological, psychological, and social perspectives into a cohesive

understanding of female ultra-athletes' pain experiences. These insights take on particular significance against the historical backdrop of female exclusion from endurance sports, as women continue to challenge perceived limitations while navigating unique biopsychosocial factors. The empirical evidence of tacit pain management strategies has important implications for practitioners, pointing toward more integrated approaches that consider both gender-specific needs and broader performance contexts. As ultra-endurance sports continue to grow in popularity and female participation increases, this research provides a valuable foundation for developing effective support strategies that enhance both performance and wellbeing in this demanding sporting domain. Furthermore, this research demonstrates how a pragmatic, pluralist philosophical framework can guide innovative MMR designs that generate both theoretical insights and practical applications, validating the temporal integration approach established in the thesis foundation.

# References

Addison, T., Kremer, J., & Bell, R. (1998). Understanding the psychology of pain in sport. *Irish Journal of Psychology, 19*(4), 486-503. https://doi.org/10.1080/03033910.1998.10558209Alaiti, R. K., & Reis, F. J. J. (2022). Modern pain science in clinical practice: Myths and misconceptions. *Journal of Clinical Medicine, 11*(2), 447. https://doi.org/10.3390/jcm11020447

Allen-Collinson, J. (2013). Narratives of and from a running-woman's body: Feminist phenomenological perspectives on running embodiment. *Leisure Studies Association Newsletter, 95*, 41-48.

Allen-Collinson, J. (2023). Pleasure and danger: A running-woman in 'public' space. *Qualitative Research in Sport, Exercise and Health, 15*, 382-396. https://doi.org/10.1080/2159676X.2022.2111460

Allen-Collinson, J., & Jackman, P. (2022). Endurance and the production of 'endurance work' in women's cross-country and trail running. In N. B. Salazar & J. Scheerder (Eds.), *Contemporary meanings of endurance: An interdisciplinary approach* (pp. 80-97). Routledge. https://doi.org/10.4324/9781003321842-6

American Psychological Association, Ethical Principles of Psychologists and Code of Conduct, Including 2010 and 2016 Amendments, https://www.apa.org/ethics/code

Anastasi, A. (1989). *Psychological testing*. Macmillan.

Anderson, R., & Hanrahan, S. J. (2008). Dancing in pain: Pain appraisal and coping in dancers. *Journal of Dance Medicine & Science, 12*(1), 9–16.

Anstiss, P. A., Meijen, C., & Marcora, S. M. (2020). The sources of self-efficacy in experienced and competitive endurance athletes. *International Journal of Sport and Exercise Psychology, 18*, 622-638. https://doi.org/10.1080/1612197X.2018.1549584

Antonini-Philippe, R., Rochat, N., Vauthier, M., & Hauw, D. (2016). The story of

    withdrawals during an ultra-trail running race: A qualitative investigation of runners'

    courses of experience. *The Sport Psychologist, 30*, 361-375.

    http://dx.doi.org/10.1123/tsp.2016-0039

Armstrong, L. E., Casa, D. J., Emmanuel, H., Ganio, M. S., Klau, J. F., Lee, E. C., Maresh,

    C. M., McDermott, B. P., Stearns, R., Vingren, J., Wingo, J. E., Williamson, K. H., &

    Yamamoto, L. M. (2012). Nutritional, physiological, and perceptual responses during

    a summer ultra-endurance cycling event. *Journal of Strength and Conditioning*

    *Research, 26*, 307–318.

Asmundson, G. J. G., & Wright, K. D. (2012). Biopsychosocial approaches to pain. In T.

    Hadjistavropoulos & K. D. Craig (Eds.), *Pain psychological perspectives* (pp. 35-58).

    Psychology Press.

Assa, T., Geva, N., Zarkh, Y., & Defrin, R. (2019). The type of sport matters: Pain perception

    of endurance athletes versus strength athletes. *European Journal of Pain, 23*, 686–

    696. https://doi.org/10.1002/ejp.1335

Astokorki, A. H. Y., & Mauger, A. R. (2017). Transcutaneous electrical nerve stimulation

    reduces exercise-induced perceived pain and improves endurance exercise

    performance. *European Journal of Applied Physiology, 117*, 483–492.

    https://doi.org/10.1007/s00421-016-3532-6

Atkinson, M. (2008). Triathlon, suffering and exciting significance. *Leisure Studies, 27*, 165–

    180. https://doi.org/10.1080/02614360801902216

Baker, J., Côté, J., & Deakin, J. (2005). Expertise in ultra-endurance triathletes early sport

    involvement, training structure, and the theory of deliberate practice. *Journal of*

    *Applied Sport Psychology, 17*(1), 64-78. https://doi.org/10.1080/10413200590907577

Bale, J. (2006). The place of pain in running. In S. Loland, B. Skirstad, & I. Waddington (Eds.), *Pain and injury in sport* (1st ed.). Routledge.

Balk, Y. A., & Englert, C. C. (2020). Recovery self-regulation in sport: Theory, research, and practice. *International Journal of Sports Science and Coaching, 15*, 273-281. https://doi.org/10.1177/1747954119897528

Bandura, A. (1986). *Social foundations of thought and action: A Social Cognitive Theory*. Prentice-Hall.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organisational Behaviour and Human Decision Processes, 50*, 248-281.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.

Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*(1), 87-99.

British Psychological Society (2021). Code of Human Research Ethics. Leicester: Author www.bps.org.uk/news-and-policy/bps-code-human-research-ethics

Barnett, A., Cerin, E., Reaburn, P., & Hooper, S. (2012). The effects of training on performance and recovery in simulated multi-day cycling events. *International Journal of Sports Physiology and Performance, 7*(4), 363-373.

Bastian, B., Jetten, J., Hornsey, M. J., & Leknes, S. (2014). The positive consequences of pain: A biopsychosocial approach. *Personality and Social Psychology Review, 18*, 256-278. https://doi.org/10.1177/1088868314527831

Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. *Current Directions in Psychological Science, 16*(6), 351-355. https://doi.org/10.1111/j.1467-8721.2007.00534.x

Baumgartner, S., Sousa, C. V., Nikolaidis, P. T., & Knechtle, B. (2020). Can the performance gap between women and men be reduced in ultra-cycling? *International Journal of*

*Environmental Research and Public Health*, *17*(7), Article 2521.

https://doi.org/10.3390/ijerph17072521

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and

implementation for novice researchers. *The Qualitative Report, 13*(4), 544-559.

https://doi.org/10.46743/2160-3715/2008.1573

Bazeley, P. (2024). Conceptualizing integration in mixed methods research. *Journal of Mixed

Methods Research*, *18*(3), 225-234. https://doi.org/10.1177/15586898241253636

Beauchamp, T. L., & Childress, J. F. (2019). *Principles of biomedical ethics* (8th ed.). Oxford

University Press.

Bean, C., & Wimbs, R. (2021). Running from (with) mom guilt: Exploring experiences of

being a mother and training for and running marathons. *Leisure/Loisir, 45*(2), 245-

267. https://doi.org/10.1080/14927713.2021.1874831

Behnke, M., Macaluso, F., Brupbacher, G., Ottenheijm, C., & Zonderland, M. L. (2021). Sex-

specific differences in recovery strategies for ultramarathon running: A systematic

review. *Sports Medicine, 51*(4), 671-685. https://doi.org/10.1007/s40279-020-01402-9

Bender, A. M., Lawson, D., Werthner, P., Samuels, C., & Boggess, C. (2018). The clinical

validation of the Athlete Sleep Screening Questionnaire: An instrument to identify

athletes that need further sleep assessment. *Sports Medicine - Open, 4*(1), 23.

https://doi.org/10.1186/s40798-018-0140-5

Berger, N., Cooley, D., Graham, M., Harrison, C., & Best, R. (2020). Case report:

Physiological responses and nutritional intake during a 7-day treadmill running world

record. *International Journal of Environmental Research and Public Health, 17*,

5962. https://doi.org/10.3390/ijerph17165962

Bernardes, S. F., Keogh, E., & Lima, M. L. (2008). *Bridging the gap between pain and gender research: A selective literature review. European Journal of Pain, 12*(4), 427–440. https://doi.org/10.1016/j.ejpain.2007.08.007

Biggins, M., Purtill, H., Fowler, P., Bender, A., Sullivan, K. O., Samuels, C., & Cahalan, R. (2021). Sleep, health, and well-being in elite athletes from different sports: An exploratory investigation. *PloS One, 16*(8), e0256614.

Bluhm, K., & Ravn, S. (2022). 'It has to hurt': A phenomenological analysis of elite runners' experiences in handling non-injuring running-related pain. *Qualitative Research in Sport, Exercise and Health, 14*(2), 216-231. https://doi.org/10.1080/2159676X.2021.1901136

Bluhm, K., & Ravn, S. (2023). Running identities, pain and performance: A case study of recreational runners. *Qualitative Research in Sport, Exercise and Health*. https://doi.org/10.1080/2159676X.2023.2277387

Boat, R., & Taylor, I. M. (2017). Prior self-control exertion and perceptions of pain during a physically demanding task. *Psychology of Sport and Exercise, 33*, 1-6. http://dx.doi.org/10.1016/j.psychsport.2017.07.005

Boat, R., Williamson, O., Read, J., Jeong, Y. H., & Cooper, S. B. (2021). Self-control exertion and caffeine mouth rinsing: Effects on cycling time-trial performance. *Psychology of Sport & Exercise, 53*, 101877. https://doi.org/10.1016/j.psychsport.2021.101877

Boholm, Å., & Corvellec, H. (2011). A relational theory of risk. *Journal of Risk Research, 14*(2), 175–190. https://doi.org/10.1080/13669877.2010.515313

Bolling, C., Barboza, S. D., Van Mechelen, W., & Pasman, H. R. (2019). How elite athletes, coaches, and physiotherapists perceive a sports injury. *Translational Sports Medicine, 2*, 17–23. https://doi.org/10.1002/tsm2.53

Bootcov, M. (2019). Australian female endurance cyclists of the 1930s and the commercialization of their athletic femininity. *The International Journal of the History of Sport, 36*, 1433-1456. https://doi.org/10.1080/09523367.2020.1713107

Boudreault, V., Desmeules, F., Roy, J.-S., Dionne, C. E., Frémont, P., & MacDermid, J. C. (2022). Psychosocial risk factors for overuse injuries in competitive athletes: A mixed-studies systematic review. *Sports Medicine*, *52*(4), 933-960. https://doi.org/10.1007/s40279-021-01597-5

Boukelia, B., Fogarty, M. C., Davison, R. C. R., & Florida-James, G. D. (2018). Diurnal physiological and immunological responses to a 10-km run in highly trained athletes in an environmentally controlled condition of 6°C. *European Journal of Applied Physiology, 118*(2), 401-409. https://doi.org/10.1007/s00421-017-3784-9

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. Sage.

Brener, N. D., Billy, J. O., & Grady, W. R. (2003). Assessment of factors affecting the validity of self-reported health-risk behaviour among adolescents: Evidence from the scientific literature. *Journal of Adolescent Health, 33*, 436-457.

Brick, N. E., MacIntyre, T. E., & Campbell, M. J. (2015). Metacognitive processes in the self-regulation of performance in elite endurance runners. *Psychology of Sport and Exercise, 19*, 1-9. https://doi.org/10.1016/j.psychsport.2015.02.003

Brick, N. E., MacIntyre, T. E., & Campbell, M. J. (2016). Thinking and action: A cognitive perspective on self-regulation during endurance performance. *Frontiers in Physiology, 7*, 159. https://doi.org/10.3389/fphys.2016.00159

British Psychological Society. (2021). *BPS code of human research ethics*. https://www.bps.org.uk/guideline/bps-code-human-research-ethics

Buman, M. P., Omli, J. W., Giacobbi, Jr. P. R., & Brewer, B. W. (2008). Experiences and coping responses of "hitting the wall" for recreational marathon runners. *Journal of Applied Sport Psychology, 20*, 282-300.

Burckhardt, C. S., & Jones, K. D. (2003). Adult measures of pain: The McGill Pain Questionnaire (MPQ), Rheumatoid Arthritis Pain Scale (RAPS), Short-Form McGill Pain Questionnaire (SF-MPQ), Verbal Descriptive Scale (VDS), Visual Analog Scale (VAS), and West Haven-Yale Multidisciplinary Pain Inventory (WHYMPI). *Arthritis & Rheumatism (Arthritis Care & Research), 49*(5S), S96-S104. https://doi.org/10.1002/art.11440

Burfoot, A. (2014). *First ladies of running: 22 inspiring profiles of the rebels, rule breakers, and visionaries who changed sport forever*. Rodale.

Burke, S. (2016). Rethinking 'validity' and 'trustworthiness' in qualitative inquiry: How might we judge the quality of qualitative research in sport and exercise sciences? In B. Smith & A. C. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and exercise* (pp. 330-339). Routledge. https://doi.org/10.4324/9781315762012

Bursik, J., John, J. M., Mayer, J., Thiel, A., & Kühnle, F. (2025). "Anyone who weighs up risks doesn't belong here": How do elite handball players manage physical health risk throughout their professional careers? *Frontiers in Sports and Active Living, 7*, 1553948. https://doi.org/10.3389/fspor.2025.1553948

Bursik, J., Thiel, A., Mayer, J., & John, J. M. (2025). The role of psychosocial factors in performing hurt: A systematic review covering the high-performance domains of sport, music, and dance. *International Review of Sport and Exercise Psychology*. https://doi.org/10.1080/1750984X.2025.2450791

Cachia, M., & Millward, L. (2011). The telephone medium and semi-structured interviews: A complementary fit. *Qualitative Research in Organisations and Management, 6*, 265–277. https://doi.org/10.1108/17465641111188420

Carless, D., & Douglas, K. (2013). Living, resisting and playing the part of athlete: Narrative tensions in elite sport. In K. Douglas & D. Carless (Eds.), A history of performative social science (pp. 195–212). Routledge.

Capranica, L., Piacentini, M. F., Halson, S., Myburgh, K. H., Ogasawara, E., & Millard-Stafford, M. (2013). The gender gap in sport performance: Equity influences equality. *International Journal of Sports Physiology and Performance*, *8*(6), 99–103. https://doi.org/10.1123/ijspp.8.1.99

Carter, J. E., & Houle, J. (2019). Clinical issues in endurance performance. In C. Meijen (Ed.), *Endurance performance in sport: Psychological theory and interventions* (pp. 189-200). Routledge.

Cervero, F. (2013). Editorial III: Pain research: What have we learned and where are we going. *British Journal of Anaesthesia, 111*, 6–8. https://doi.org/10.1093/bja/aet209

Chaffee, A., Yakuboff, M., & Tanabe, T. (2011). Responsiveness of the VAS and McGill Pain Questionnaire in measuring changes in musculoskeletal pain. *Journal of Sport Rehabilitation, 20*, 250-255.

Chappell, E. (2019). *Where there's a will: Hope, grief and endurance in a cycle race across a continent*. Pursuit Books.

Chapman, C. R. (1980). Pain, and perception: Comparison of sensory decision theory and evoked potential methods. In J. J. Bonica (Ed.), *Pain* (pp. 111-142). Raven Press.

Charlesworth, H., & Young, K. (2006). Injured female athletes. In S. Loland, B. Skirstad, & I. Waddington (Eds.), *Pain and sport injury: Social and ethical analysis* (pp. 89-106). Routledge.

Clarke, N. J., Caddick, N., & Frost, N. (2016). Pluralistic data analysis: Theory and practice. In B. Smith & A. C. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and exercise* (pp. 181–194). Routledge. https://doi.org/10.4324/9781315762012

Cleary, T. J., & Zimmerman, B. J. (2001). Self-regulation differences during athletic practice by experts, non-experts, and novices. *Journal of Applied Sport Psychology, 13*(2), 185-206. https://doi.org/10.1080/104132001753149883

Coakley, J. (2015). Assessing the sociology of sport: On cultural sensibilities and the great sport myth. *International Review for the Sociology of Sport*, *50*(4–5), 402–406. https://doi.org/10.1177/1012690214538864

Coen, S. E., Downie, V., Follett, L., Moore, J., & Pringle, A. (2024). What do we know about women's experiences of recreational team sport participation across the life course? A rapid review. *British Journal of Sports Medicine*, *58*(24), 1505–1517. https://doi.org/10.1136/bjsports-2024-108175

Coen, S. E., Downie, V., Follett, L., McCaig, S., & Parsons, J. L. (2024). Gendered environmental pathways to sports injury: insights from retired athletes in the UK high-performance context. *British Journal of Sports Medicine*, *58*(24), 1505–1517. https://doi.org/10.1136/bjsports-2024-108717

Coker-Cranney, A., Watson, J. C., Bernstein, M., Voelker, D. K., & Coakley, J. (2018). How far is too far? Understanding identity and overconformity in collegiate wrestlers. *Qualitative Research in Sport, Exercise and Health, 10*(1), 92–116. https://doi.org/10.1080/2159676X.2017.1372798

Cook, D. B., O'Connor, P. J., Eubanks, S. A., Smith, J. C., & Lee, M. (1997). Naturally occurring muscle pain during exercise: Assessment and experimental evidence. *Medicine Science Sports Exercise, 29*, 999–1012. https://doi.org/10.1097/00005768-199708000-00004

Copeland, J. L., & Verzosa, M. L. S. (2014). Endocrine response to an ultra-marathon in pre- and post-menopausal women. *Biology of Sport, 31*, 125-131. https://doi.org/10.5604/20831862.1097480

Corrigan, J., & Onwuegbuzie, A. (2023). Towards sampling designs that are transparent, rigorous, ethical and equitable (TREE): Using a tree metaphor as a sampling meta-framework in mixed methods research. In C. N. Poth (Ed.), *The Sage handbook of mixed methods research design* (pp. 2–26). Sage Publications Ltd. https://doi.org/10.4135/9781529614572.n15

Corrion, K., Morales, V., Bergamaschi, A., Massiera, B., Morin, J-B., & d'Arripe-Longueville, F. (2018). Psychosocial factors as predictors of dropout in ultra-trailers. *PLoS ONE, 13*, e0206498. https://doi.org/10.1371/journal.pone.0206498

Coubertin, P. de (1912). 'The Women at the Olympic Games', in Coubertin, Pierre de, *Olympism: selected writings*. Lausanne: IOC, 2000, pp. 711– 713. In Polley, M. (2014). Sport, gender, and sexuality at the 1908 London Olympic Games. In J. Hargreaves & E. Anderson (Eds.), *Routledge handbook of sport, gender, and sexuality*. Taylor and Francis Group.

Coutts, A. J., Wallace, L. K., & Slattery, K. M. (2007). Monitoring changes in performance, physiology, biochemistry, and psychology during overreaching and recovery in triathletes. *International Journal of Sports Medicine, 28*(02), 125-134.

Cowley, E. S., Moore, S. R., Olenick, A. A., & McNulty, K. L. (2024). "Invisible Sportswomen 2.0"—Digging deeper into gender bias in sport and exercise science research: Author gender, editorial board gender, and research quality. *Women in Sport and Physical Activity Journal*, *32*(1), 1–8. https://doi.org/10.1123/wspaj.2023-0058Creer, A., Robison, K., Clawson, A., Foote, N., Moody, C., & Kelly, M. (2024). Gastrointestinal responses and hydration status in mountain ultramarathon runners.

*Medicine & Science in Sports & Exercise, 56*(10S), 639-639.

https://doi.org/10.1249/01.mss.0001058156.48878.f1

Cresswell, J. W., & Cresswell, J. D. (2020). *Research design: qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Cronan, M. K., & Scott, D. (2008). Triathlon and women's narratives of bodies and sport. *Leisure Sciences, 30*, 17-34. https://doi.org/10.1080/01490400701544675

Curran, T., Hill, A. P., Appleton, P. R., Vallerand, R. J., & Standage, M. (2015). The psychology of passion: A meta-analytical review of a decade of research on intrapersonal outcomes. *Motivation and Emotion, 39*, 631–655. https://doi.org/10.1007/s11031-015-9503-0

Cushman, M. W., Bullers, A. M., & Meyers, M. C. (2018). Pain coping skills of female ultrarunners. *Medicine & Science in Sports & Exercise, 50*(5S), 514. https://doi.org/10.1249/01.mss.0000536776.82362.da

Defrin, R., Shramm, L., & Eli, I. (2009). Gender role expectations of pain is associated with pain tolerance limit but not with pain threshold. *Pain*, *145*(3), 230–236. https://doi.org/10.1016/j.pain.2009.06.028

Derman, W. (2018). "Deromanticising" the image of pain in athletes. *Clinical Journal of Sport Medicine, 28*(5), 399-400.

Deroche, T., Woodman, T., Stephan, Y., Brewer, B. W., & Le Scanff, C. (2011). Athletes' inclination to play through pain: A coping perspective. *Anxiety, Stress, and Coping, 24*, 579–587. https://doi.org/10.1080/10615806.2011.552717

Descartes, R. (1664). *Traité de l'homme*. Paris: Angot.

Di Fronso, S., Tamburro, G., Robazza, C., Bortoli, L., Comani, S., & Bertollo, M. (2018). Focusing attention on muscle exertion increases EEG coherence in an endurance cycling task. *Frontiers in Psychology, 9*, 1249. https://doi.org/10.3389/fpsyg.2018.01249

Diener, E., Heintzelman, S. J., Kushlev, K., Tay, L., Wirtz, D., Lutes, L. D., & Oishi, S. (2017). Findings all psychologists should know from the new science on subjective wellbeing. *Canadian Psychology, 58*(2), 87-104. https://doi.org/10.1037/cap0000063

Dijkstra, H. P., Pollock, N., Chakraverty, R., & Alonso, J. M. (2014). Managing the health of the elite athlete: A new integrated performance health management and coaching model. *British Journal of Sports Medicine, 48*(7), 523-531. https://doi.org/10.1136/bjsports-2013-093222

Douglas, K., & Carless, D. (2006). Performance, discovery, and relational narratives among women professional tournament golfers. *Women in Sport and Physical Activity Journal, 15*(2), 14–27. https://doi.org/10.1123/wspaj.15.2.14

Douglas, K., & Carless, D. (2009). Abandoning the performance narrative: Two women's stories of transition from professional sport. *Journal of Applied Sport Psychology*, *21*(2), 213–230. https://doi.org/10.1080/10413200902795109

Douglas, K., & Carless, D. (2015). *Life story research in sport : understanding the experiences of elite and professional athletes through narrative / Kitrina Douglas and David Carless.* Routledge, Taylor & Francis Group.

Drew, M., Vlahovich, N., Hughes, D., Appaneal, R., Peterson, K., Burke, L., Lundy, B., & Halson, S. (2018). Prevalence of illness, poor mental health and sleep quality and low energy availability prior to the 2016 Summer Olympic Games. *British Journal of Sports Medicine, 52*(1), 47–53. https://doi.org/10.1136/bjsports-2017-098208

Eccles, D. W., & Arsal, G. (2017). The think-aloud method: What is it and how do I use it? *Qualitative Research in Sport, Exercise and Health, 9*, 514-531. https://doi.org/10.1080/2159676X.2017.1331501

Elliott-Sale, K. J., Minahan, C. L., Janse de Jonge, X. A. K., Ackerman, K. E., Sipilä, S., Constantini, N. W., Lebrun, C. M., & Hackney, A. C. (2021). Methodological considerations for studies in sport and exercise science with women as participants: A working guide for standards of practice for research on women. *Sports Medicine*, *51*(5), 843–861. https://doi.org/10.1007/s40279-021-01435-8

Encarnacion, M. L. G., Meyers, M. C., Ryan, N. D., & Pease, D. G. (2000). Pain coping styles of ballet performers. *Journal of Sport Behaviour, 23*(1), 20-32.

Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science, 196*(4286), 129-136. https://doi.org/10.1126/science.847460

Ericsson, K. A., & Kirk, E. P. (2001). The search for fixed generalizable limits of "pure STM" capacity: Problems with theoretical proposals based on independent chunks. *Behavioural and Brain Sciences, 24*, 120–121. https://doi.org/10.1017/s0140525x01283927

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87*(3), 215-251. https://doi.org/10.1037/0033-295X.87.3.215

Ericsson, K. A., & Simon, H. A. (1993). *Verbal reports as data* (Rev. ed.). MIT Press.

Etxebarria, N., Mujika, I., & Pyne, D. B. (2019). Training and competition readiness in triathlon. *Sports, 7*(5), 101. https://doi.org/10.3390/sports7050101

Evans, M. B., Hoar, S. D., Gebotys, R. J., & Marchesin, C. A. (2014). Endurance athletes' coping function use during competitive suffering episodes. *European Journal of Sport Science, 14*, 368-375. https://doi.org/10.1080/17461391.2013.832803

Feilzer, M. Y. (2010). Doing mixed methods research pragmatically: Implications for the
rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods
Research, 4*(1), 6–16. https://doi.org/10.1177/1558689809349691

Fetters, M. D., & Freshwater, D. (2015). Publishing a methodological mixed methods
research article. *Journal of Mixed Methods Research, 9*, 203–213.
https://doi.org/10.1177/1558689815594687

Fetters, M. D., & Molina-Azorin, J. F. (2017). The Journal of Mixed Methods Research starts
a new decade: Principles for bringing in the new and divesting of the old language of
the field. *Journal of Mixed Methods Research*, *11*(1), 3-10.
https://doi.org/10.1177/1558689816682092

Finlay, L. (2002). "Outing" the researcher: The provenance, process, and practice of
reflexivity. *Qualitative Health Research, 12*(4), 531-545.
https://doi.org/10.1177/104973202129120052

Finlay, L. (2014). Engaging phenomenological analysis. *Qualitative Research in Psychology,
11*, 121-141. https://doi.org/10.1080/14780887.2013.807899

Finlay, K. A., Peacock, S., & Elander, J. (2018). Developing successful social support: An
interpretative phenomenological analysis of mechanisms and processes in a chronic
pain support group. *Psychology & Health, 33*, 846-871.
https://doi.org/10.1080/08870446.2017.1421188

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive
developmental inquiry. *American Psychologist, 34*, 906-911.

Fondation Alice Milliat. (n.d.). Alice Milliat. Retrieved July 19, 2020, from
https://www.fondationalicemilliat.com/alice-milliat

Fox-Harding, C., & Kendall, K. (2024). The longer the race, the closer it gets: Women are
closing in on men in the ultra-endurance arena. The Guardian. Retrieved December

30, 2024 from https://www.theguardian.com/lifeandstyle/2024/dec/30/the-longer-the-race-the-closer-it-gets-women-are-closing-in-on-men-in-the-ultra-endurance-arena

Freund, W., Weber, F., Billich, C., Birklein, F., Breimhorst, M., & Schuetz, U. H. (2013). Ultra-marathon runners are different: Investigations into pain tolerance and personality traits of participants of the Trans Europe Foot Race 2009. *Pain Practice, 13*, 524–532. https://doi.org/10.1111/papr.12039

Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N., & Turk, D. C. (2007). The biopsychosocial approach to chronic pain: Scientific advances and future directions. *Psychological Bulletin, 133*(4), 581-624. https://doi.org/10.1037/0033-2909.133.4.581

Geva, N., & Defrin, R. (2013). Enhanced pain modulation among triathletes: A possible explanation for their exceptional capabilities. *Pain, 154*, 2317–2323.

Geva, N., Pruessner, J., & Defrin, R. (2017). Triathletes lose their advantageous pain modulation under acute psychosocial stress. *Medicine & Science in Sports & Exercise, 49*, 333-341. https://doi.org/10.1249/MSS.0000000000001110

Ghiara, V. (2020). Disambiguating the role of paradigms in mixed methods research. *Journal of Mixed Methods Research*, *14*(1), 11-25. https://doi.org/10.1177/1558689818819928

Giles, G. E., Cantelon, J. A., Eddy, M. D., Brunyé, T. T., Urry, H. L., Taylor, H. A., Mahoney, C. R., & Kanarek, R. B. (2018). Cognitive reappraisal reduces perceived exertion during endurance exercise. *Motivation and Emotion, 42*, 482–496. https://doi.org/10.1007/s11031-018-9697-z

Glazier, P. S. (2017). Towards a Grand Unified Theory of sports performance. *Human Movement Science, 56*, 139-156. http://dx.doi.org/10.1016/j.humov.2015.08.001

Grim, C. (2020). Triathlon – An individual multidiscipline sport with a multidisciplinary approach for the athletes' health. *Deutsche Zeitschrift für Sportmedizin, 71*, 227-228. https://doi.org/10.5960/dzsm.2020.464

Grinyer, A., & Thomas, C. (2012). The value of interviewing on multiple occasions or

    longitudinally. In J. F. Gubrium, J. A. Holstein, A. B. Marvasti, & K. D. McKinney

    (Eds.), *The SAGE handbook of interview research: The complexity of the craft* (2nd

    ed., pp. 219–230). SAGE Publications. https://doi.org/10.4135/9781452218403.n14

Gross, T. (2021). Some people smoke and drink, I run: Addiction to running through an

    ethnographic lens. *Leisure Sciences*. https://doi.org/10.1080/01490400.2021.1877583

Guerin, E., Fortier, M. S., & Williams, T. (2013). "I just NEED to move...": Examining

    women's passion for physical activity and its relationship with daily affect and

    vitality. *Psychology of Wellbeing: Theory, Research and Practice, 3*, 1-24.

    http://dx.doi.org/10.1186/2211-1522-3-4

Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating quantitative and

    qualitative results in health science mixed methods research through joint displays.

    *The Annals of Family Medicine, 13*(6), 554-561.

Hadjistavropoulos, T. (2012). Ethics for psychologists who treat, assess, and/or study pain. In

    T. Hadjistavropoulos & K. D. Craig (Eds.), *Pain: Psychological perspectives* (pp.

    327-344). Lawrence Erlbaum Associates Publishers.

Hadjistavropoulos, T., & Craig, K. D. (Eds.). (2012). *Pain: Psychological perspectives*.

    Lawrence Erlbaum Associates Publishers.

Hainline, B., Turner, J. A., Caneiro, J. P., Stewart, M., & Moseley, G. L. (2017). Pain in elite

    athletes—neurophysiological, biomechanical and psychosocial considerations: A

    narrative review. *British Journal of Sports Medicine, 51*, 1259–1264.

    https://doi.org/10.1136/bjsports-2017-097890

Hall, L., Rhodes, P., & Papathomas, A. (2022). Embodied experiences of injured endurance

    runners: A qualitative meta-synthesis. *Qualitative Research in Sport, Exercise and

    Health, 14*, 628-647. https://doi.org/10.1080/2159676X.2021.1989020

Hall, L., & Rhodes, P. (2024). The embodied experiences of injured ultra runners: A body mapping study. *Human Arenas*. https://doi.org/10.1007/s42087-024-00443-0

Hallam, L. C., & Amorim, F. T. (2022). Expanding the gap: An updated look into sex differences in running performance. *Frontiers in Physiology*, *12*, Article 804149. https://doi.org/10.3389/fphys.2021.804149

Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. *Sports Medicine, 44*(2), 139-147. https://doi.org/10.1007/s40279-014-0253-z

Hamilton, B. (2018). East German sports medicine and doping: Honoured in the breach or observance? *Sport in Society, 21*(1), 84–94. https://doi.org/10.1080/17430437.2016.1225927

Hamilton, B. (2019). Medical practice with elite athletes. In D. Collins, A. Cruickshank, & G. Jordet (Eds.), *Routledge handbook of elite sport performance* (1st ed., pp. 143–157). Routledge. https://doi.org/10.4324/9781315266343

Hanold, M. T. (2010). Beyond the marathon: (De)construction of female ultrarunning bodies. *Sociology of Sport Journal, 27*, 160–177. https://doi.org/10.1123/ssj.27.2.160

Harford, T. (2025, July 25). Why endurance sport is the new escape. *BBC Travel*. https://www.bbc.com/travel/article/20250725-why-endurance-sport-is-the-new-escape

Harriss, D. J., MacSween, A., & Atkinson, G. (2019). Ethical Standards in Sport and Exercise Science Research: 2020 Update. *International journal of sports medicine*, *40*(13), 813–817. https://doi.org/10.1055/a-1015-3123

Hatzigeorgiadis, A., Bartura, K., Argiropoulos, C., Comoutos, N., Galanis, E., & Flouris, A. D. (2018). Beat the heat: effects of a motivational self-talk intervention on endurance performance. *Journal of Applied Sport Psychology, 30*(4), 388-401. https://doi.org/10.1080/10413200.2017.1395930

Hausenblas, H. A., & Symons Downs, D. (2002). Exercise dependence: A systematic review. *Psychology of Sport and Exercise, 3*(2), 89-123. https://doi.org/10.1016/S1469-0292(00)00015-7

Heil, J. (2012). Pain on the run: Injury, pain and performance in a distance runner. *The Sport Psychologist, 26*, 540-550. https://doi.org/10.1123/tsp.26.4.540

Hicks, M. (2014). Markers of change. *Marathon & Beyond, 1*, 178-183.

Hochstetler, D., & Hopsicker, P. M. (2016). Normative concerns for endurance athletes. *Journal of the Philosophy of Sport, 43*, 335-349. https://doi.org/10.1080/00948705.2016.1163226

Hockey, J., & Allen-Collinson, J. (2016). Digging in: The sociological phenomenology of 'doing endurance' in distance-running. In W. Bridel, P. Markula, & J. Denison (Eds.), *Endurance running: A socio-cultural examination* (pp. 227-242). Routledge.

Hoffman, M. D., & Fogard, K. (2011). Factors related to successful completion of a 161-km ultramarathon. *International Journal of Sports Physiology and Performance, 6*, 25-37.

Holt, N. L., Lee, H., Kim, Y., & Klein, K. (2014). Exploring experiences of running an ultramarathon. *The Sport Psychologist, 28*, 22–35. https://doi.org/10.1123/tsp.2013-0008

Huber, O. (2012). Risky decisions: Active risk management. Current Directions in Psychological Science, 21(1), 26–30. https://doi.org/10.1177/0963721411422055

Hughes, R., & Coakley, J. (1991). Positive deviance among athletes: The implications of overconformity to the sport ethic. *Sociology of Sport Journal, 8*(4), 307–325. https://doi.org/10.1123/ssj.8.4.307

Hunter, S. K., Angadi, S. S., Bhargava, A., Harper, J., Hirschberg, A. L., Levine, B. D., Moreau, K. L., Nokoff, N. J., Stachenfeld, N. S., Starred, S., Stellingwerff, T., & Bermon, S. (2023). The biological basis of sex differences in athletic performance:

Consensus statement for the American College of Sports Medicine. *Translational Journal of the American College of Sports Medicine*, *8*(4), 1–33. https://doi.org/10.1249/TJX.0000000000000236

IASP. (2020, December 9). Definition of pain. *International Association for the study of pain*. https://www.iasp-pain.org

International Association for the Study of Pain. (2020). *IASP ethics guidelines for pain research in humans*. https://www.iasp-pain.org/resources/guidelines/ethical-guidelines-for-pain-research-in-humans/

Iacono, L. V., Symonds, P., & Brown, D. (2016). Skype as a tool for qualitative research interviews. *Sociological Research Online, 21*, 103-117. https://doi.org/10.5153/sro.3952

International Ultra Triathlon Association. (2015). *Results Deca Ultra Triathlon Day in León 2015*. https://www.iutasport.com/ultra-triathlon-results/results-2015/results-deca-ultra-triathlon-day-in-leon-2015

International Ultra Triathlon Association. (2016). *Results Deca Ultra Triathlon Day in Buchs 2016*. https://www.iutasport.com/ultra-triathlon-results/results-2016/results-deca-ultra-triathlon-day-in-buchs-2016

International Ultra Triathlon Association. (2017). *Results Deca Ultra Triathlon in León 2017*. https://www.iutasport.com/ultra-triathlon-results/results-2017/results-deca-ultra-triathlon-in-leon-2017

International Ultra Triathlon Association. (2019). *Results Double Deca Ultra Triathlon in León 2019*. https://www.iutasport.com/ultra-triathlon-results/results-2019/results-double-deca-ultra-triathlon-in-leon-2019

International Ultra Triathlon Association. (2025a). *Results Deca Ultra Triathlon in Rio de Janeiro 2025*. https://www.iutasport.com/ultra-triathlon-results/results-2025/results-deca-ultra-triathlon-in-rio-de-janeiro-2025

International Ultra Triathlon Association. (2025b). *Results Double Ultra Triathlon WC in Emsdetten 2025*. https://www.iutasport.com/ultra-triathlon-results/results-2025/results-double-ultra-triathlon-wc-in-emsdetten-2025

International Ultra Triathlon Association. (2025c). *World records*. https://www.iutasport.com/records/world-records

Ivankova, N. V., Anderson, J. L., Herbey, I. I., Roussel, L. A., & Kim, D. (2024). Realizing methodological potentials and advantages of mixed methods research design for knowledge translation. In C. N. Poth (Ed.), *The SAGE handbook of mixed methods research design* (pp. 573-598). SAGE Publications.

Ivarsson, A., Johnson, U., & Andersen, M. B. (2017). Psychosocial factors and sport injuries: Meta-analyses for prediction and prevention. *Sports Medicine, 47*(2), 353–365. https://doi.org/10.1007/s40279-016-0591-y

Jackman, P. C., Crust, L., & Swann, C. (2017). Systematically comparing methods used to study flow in sport: A longitudinal multiple-case study. *Psychology of Sport and Exercise, 32*, 113-123. https://doi.org/10.1016/j.psychsport.2017.06.009

Jackman, P. C., Hawkins, R. M., Whitehead, A. E., & Brick, N. E. (2021). Integrating models of self-regulation and optimal experiences: A qualitative study into flow and clutch states in recreational distance running. *Psychology of Sport and Exercise, 57*, 102051. https://doi.org/10.1016/j.psychsport.2021.102051

Jackman, P. C., Schweickle, M. J., Goddard, S. G., Vella, S. A., & Swann, C. (2022). The event-focused interview: What is it, why is it useful, and how is it used? *Qualitative*

*Research in Sport, Exercise and Health*, *14*(2), 167–180.

https://doi.org/10.1080/2159676X.2021.1904442

Jackman, P. C., Whitehead, A. E., Swann, C., & Brick, N. E. (2024a). Self-regulatory

processes in goal striving during excellent distance-running performances: A

qualitative study. *Psychology of Sport and Exercise, 67*, 102354.

https://doi.org/10.1016/j.psychsport.2023.102354

Jackman, P. C., Whitehead, A. E., Brick, N. E., & Wadey, R. (2024b). "The story just brings

the science to life": Exploring the use of stories to translate knowledge about self-

regulatory processes during goal striving in running. *International Journal of Sport*

*and Exercise Psychology*. https://doi.org/10.1080/1612197X.2024.2301342

Jackman, P. C., Cowley, E. S., Ní Chéilleachair, N., Liston, K., Meade, M. M., Haughey, T.

J., Faulkner, M., McCabe, C., Kitching, N., Egan, B., O'Connor, S., Hawkins, R. M.,

O'Brien, W., Murphy, N., Williamson, O., Bird, M. D., Gorman, A. J., Carlin, A.,

Everard, C., Martin, D., Holden, S., Kelly, E., & Lane, A. (2025). A scoping review

of research about women in sport: A perspective from the island of Ireland.

*Performance Enhancement & Health*, *13*, Article 100335.

https://doi.org/10.1016/j.peh.2025.100335

Jaeschke, A-M., & Sachs, M. (2012). 100,000 miles closer to a definition of mental

toughness. *Marathon & Beyond, 16*, 44-67.

Jaeschke, A-M. C., Sachs, M. L., & Dieffenbach, K. D. (2016). Ultramarathon Runners'

Perceptions of Mental Toughness: A Qualitative Inquiry. *The Sport Psychologist, 30*,

242-255. http://dx.doi.org/10.1123/tsp.2014-0153

James, N., & Busher, H. (2012). Internet Interviewing. In J. A. Holstein, J. F. Gubrium, K. D.

McKinney, & A. B. Marvasti (Eds.), *The SAGE Handbook of Interview Research* (2nd

ed., pp. 177–192). SAGE Publications, Incorporated.

https://doi.org/10.4135/9781452218403.n12

Jensen, M. P., & Karoly, P. (1991). Control beliefs, coping efforts, and adjustment to chronic

pain. *Journal of Consulting and Clinical Psychology, 59*(3), 431-438.

https://doi.org/10.1037/0022-006X.59.3.431

Jensen, M. P., Karoly, P., & Braver, S. (1994). The measurement of clinical pain intensity: A

comparison of six methods. *Pain, 57*(2), 171-177. https://doi.org/10.1016/0304-

3959(94)90118-X

Jessup, R. L. (2007). Interdisciplinary versus multidisciplinary care teams: Do we understand

the difference? *Australian Health Review, 31*, 330-331.

http://dx.doi.org/10.1071/AH070330

Jeukendrup, A. E., Jentjens, R. L., & Moseley, L. (2005). Nutritional considerations in

triathlon. *Sports Medicine, 35*, 163–181.

Johansen, K. B. J., Tjora, A., & Svela, A. (2023). Struggling to find a balance: Ultra-distance

running, family life and gender. *Qualitative Research in Sport, Exercise and Health,*

*15*(2), 202-217. https://doi.org/10.1080/2159676X.2022.2030073

Johanson, L. S., Perry, D. J., & Hadidian, W. (2024). Interpretive phenomenology and

philosophical hermeneutics: Methodological approaches. *Qualitative Health*

*Research, 34*(3), 443-453. https://doi.org/10.1177/10497323231218151

John, J. M., Wachsmuth, S., & Thiel, A. (2024). "Either or" or "as well as": Exploring the

relation between health and performance throughout the career pathways of high-

performing athletes, musicians, and mathematicians. *Sport, Exercise, and*

*Performance Psychology. Advance online publication*.

https://doi.org/10.1037/spy0000370

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14-26. https://doi.org/10.3102/0013189X033007014

Johnson, U., Kentta, G., Ivarsson, A., Alvmyren, I., & Karlsson, M. (2016). An ultra-runner's experience of physical and emotional challenges during a 10-week continental run. *International Journal of Sport and Exercise Psychology, 14*, 72-84. https://doi.org/10.1080/1612197X.2015.1035736

Johnson, L. J., Doncaster, G., Cronin, L., Williams, C., Varga, J., & Marchant, D. (2023). Well-trained, trained and recreationally trained runners' cognition during a 5km tempo run: A think-aloud study. *International Journal of Sport and Exercise Psychology*, 1-21. https://doi.org/10.1080/1612197X.2023.2207104

Johnson, M. H., Stewart, J., Humphries, S. A., & Chamove, A. S. (2012). Marathon runners' reaction to potassium iontophoretic experimental pain: Pain tolerance, pain threshold, coping and self-efficacy. *European Journal of Pain*, *16*(5), 767–774. https://doi.org/10.1002/j.1532-2149.2011.00059.x

Johnson, M. I., Hudson, M., & Ryan, C. G. (2023). Perspectives on the insidious nature of pain metaphor: We literally need to change our metaphors. *Frontiers in Pain Research*, *4*, Article 1224139. https://doi.org/10.3389/fpain.2023.1224139

Johnston, R., Cahalan, R., O'Keeffe, M., O'Sullivan, K., & Comyns, T. (2018). The associations between training load and baseline characteristics on musculoskeletal injury and pain in endurance sport populations: A systematic review. *Journal of Science and Medicine in Sport, 21*(9), 910-918. https://doi.org/10.1016/j.jsams.2018.03.001

Johnston, R., Cahalan, R., Bonnett, L., Maguire, M., Glasgow, P., Madigan, S., O'Sullivan, K., & Comyns, T. (2020). Training load and baseline characteristics associated with

new injury/pain within an endurance sporting population: A prospective study. *International Journal of Sports Physiology and Performance, 15*(5), 643–649. https://doi.org/10.1123/ijspp.2019-0021

Johnston, T. E., Close, J., Jamora, P., & Wainwright, S. F. (2020). Perceptions of risk for stress fractures: A qualitative study of female runners with and without stress fracture histories. *Physical Therapy in Sport, 43*, 143-150. https://doi.org/10.1016/j.ptsp.2020.02.013

Joslin, J., Lloyd, J. B., Kotlyar, T., & Wojcik, S. M. (2013). NSAID and other analgesic use by endurance runners during training, competition and recovery. *South African Journal of Sports Medicine, 25*(4), 101-104. https://doi.org/10.17159/2078-516X/2013/v25i4a340

Joyce, C. R., Zutshi, D. W., Hrubes, V., & Mason, R. M. (1975). Comparison of fixed interval and visual analogue scales for rating chronic pain. *European Journal of Clinical Pharmacology, 8*(6), 415-420. https://doi.org/10.1007/BF00562315

Judelson, D. A., Bagley, J. R., Schumacher, J. M., & Wiersma, L. D. (2015a). Cardiovascular and perceptual responses to an ultra-endurance channel swim: A case study. *Wilderness & Environmental Medicine, 26*, 359–365.

Judelson, D. A., Cochrane, K. A., Buckley, D. J., Dibbell, D. M., Montain, S. J., O'Connor, P. J., & Kuta, J. M. (2015b). Effect of dehydration during exercise on physiological and psychological responses. *Journal of Applied Physiology, 118*(5), 623-632. https://doi.org/10.1152/japplphysiol.00741.2014

Jull, G. A. (2017). Biopsychosocial model of disease: 40 years on. Which way is the pendulum swinging? *British Journal of Sports Medicine, 51*, 1187-1188. https://doi.org/10.1136/bjsports-2016-097362

Kallus, K. W., & Kellman, M. (2016). *RESTQ Recovery-stress questionnaires: User manual*. Pearson.

Kamei, T., Momoi, K., & Paku, C. (2021). Community nursing practice theory for promoting practical wisdom in community practice. *International Journal of Environmental Research and Public Health, 18*(7), 3645. https://doi.org/10.3390/ijerph18073645

Karos, K., Williams, A. C. de C., Meulders, A., & Vlaeyen, J. W. S. (2024). Pain as a threat to the social self: A new conceptualisation of pain-related anxiety from a social-relational perspective. *Pain, 165*(3), 545–555. https://doi.org/10.1097/j.pain.0000000000003041

Katz, J., & Melzack, R. (2011). The McGill Pain Questionnaire: Development, psychometric properties, and usefulness of the long-form, short-form, and short-form-2. In D. C. Turk & R. Melzack (Eds.), *Handbook of pain assessment* (pp. 45-66). Guilford Press.

Kellmann, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress/recovery monitoring. *Scandinavian Journal of Medicine & Science in Sports, 20*, 95–102. https://doi.org/10.1111/j.1600-0838.2010.01192.x

Kellmann, M., Bertollo, M., Bosquet, L., Brink, M., Coutts, A. J., Duffield, R., Erlacher, D., Halson, S. L., Hecksteden, A., Heidari, J., Kallus, K. W., Meeusen, R., Mujika, I., Robazza, C., Skorski, S., Venter, R., & Beckmann, J. (2018). Recovery and performance in sport: Consensus statement. *International Journal of Sports Physiology and Performance, 13*(2), 240-245. https://doi.org/10.1123/ijspp.2017-0759

Kellmann, M., & Kallus, K. W. (2001). *Recovery-Stress Questionnaire for Athletes: User manual*. Human Kinetics.

Kenttä, G., Hassmén, P., & Raglin, J. S. (2006). Mood state monitoring of training and recovery in elite kayakers. *European Journal of Sport Science, 6*(4), 245-253.

Keogh, E., Boerner, K. E., & Ogboli Nwaso, E. (2024). *Overview of sex and gender differences in human pain* [Fact sheet]. International Association for the Study of Pain. https://www.iasp-pain.org/resources/fact-sheets/

Knechtle, B., Bragazzi, N. L., Rosemann, T., & Rüst, C. A. (2015). Pacing in a self-paced world record attempt in 24-h road cycling. *SpringerPlus, 4*, 650. https://doi.org/10.1186/s40064-015-1445-1

Knechtle, B., Rüst, C. A., Knechtle, P., Rosemann, T., & Lepers, R. (2012). Age-related changes in ultra-triathlon performances. *Extreme Physiology & Medicine*, *1*, Article 5. https://doi.org/10.1186/2046-7648-1-5

Knechtle, B., Zingg, M. A., Rosemann, T., & Rüst, C. A. (2015). The aspect of experience in ultra-triathlon races. *SpringerPlus*, *4*, Article 278. https://doi.org/10.1186/s40064-015-1050-3

Knechtle, B., & Nikolaidis, P. T. (2018). Physiology and pathophysiology in ultra-marathon running. *Frontiers in Physiology, 9*, 634. https://doi.org/10.3389/fphys.2018.00634

Korstjens, I., & Moser, A. (2018). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice, 24*, 120-124. https://doi.org/10.1080/13814788.2017.1375092

Kress, J. L., & Statler, T. (2007). A naturalistic investigation of former Olympic cyclists' cognitive strategies for coping with exertion pain during performance. *Journal of Sport Behaviour, 30*, 428-452.

Lasnier, J.-L., & Durand, N. (2022). How elite endurance athletes experience and manage exercise-induced pain: Implications for mental performance consultants. *Journal of Applied Sport Psychology*. https://doi.org/10.1080/10413200.2022.2146809

Lasnier, J. M., & Durand-Bush, N. (2023). Using reflective journals to track self-regulation, wellbeing, and coping strategies: A Canadian collegiate varsity athlete's journey through the COVID-19 pandemic. *Journal of Clinical Sport Psychology, 17*(1), 35-57.

Latinjak, A. T., Font-Lladó, R., Zourbanos, N., & Hatzigeorgiadis, A. (2016). Goal-directed self-talk interventions: A single-case study with an elite athlete. *The Sport Psychologist, 30*(2), 189-194. https://doi.org/10.1123/tsp.2015-0120

Lazarus, R. S. (1999). *Stress and emotion: A new synthesis*. Springer.

Lebel, K., Mumcu, C., Pegoraro, A., LaVoi, N. M., Lough, N., & Antunovic, D. (2021). Re-thinking women's sport research: Looking in the mirror and reflecting forward. *Frontiers in Sports and Active Living*, *3*, Article 746441. https://doi.org/10.3389/fspor.2021.746441

Lepers, R. (2008). Analysis of Hawaii Ironman performances in elite triathletes from 1981 to 2007. *Medicine & Science in Sports & Exercise, 40*(10), 1828-1834. https://doi.org/10.1249/MSS.0b013e31817e91a4

Lev, A. (2019). Becoming a long-distance runner -- deriving pleasure and contentment in times of pain and bodily distress. *Leisure Studies, 38*, 790-803. https://doi.org/10.1080/02614367.2019.1640776

Lev, A. (2020). Distance runners in a dys-appearance state: The case of running-related injury. *Sociology of Sport Journal, 37*(2), 136-147. https://doi.org/10.1123/ssj.2019-0016

Lev, A. (2021). Distance runners in a dys-appearance state -- Reconceptualising the perception of pain and suffering in times of bodily distress. *Qualitative Research in Sport, Exercise and Health, 13*, 473-487. https://doi.org/10.1080/2159676X.2020.1734647

Levitt, H. M., Bamberg, M., Creswell, J. W., Frost, D. M., Josselson, R., & Suárez-Orozco, C. (2018). Journal article reporting standards for qualitative primary, qualitative meta-analytic, and mixed methods research in psychology: The APA Publications and Communications Board task force report. *American Psychologist, 73*(1), 26-46. https://doi.org/10.1037/amp0000151

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.

Liston, K., Byrne, H., & O'Riordan, M. (2021). Editorial. *Studies in Arts and Humanities*, *7*(1), 1–4. https://sahjournal.com

Lyshon, S. C., & Wicklander, G. W. (1987). Assessing pain in physically active subjects. *Medical Science in Sports and Exercise, 19*(2), 148-154.

MacDonald, J., Doyle-Baker, P. K., & Schaefer, L. M. (2023). Tracking symptoms, mood, and nutritional intake in female athletes across a competitive season. *International Journal of Exercise Science, 16*(6), 265-280.

Madrigal, L., Robbins, J., Gill, D. L., & Wurst, K. (2015). A pilot study investigating the reasons for playing through pain and injury: Emerging themes in men's and women's collegiate rugby. *The Sport Psychologist*, *29*(4), 310–318. https://doi.org/10.1123/tsp.2014-0139

Macquet, A. C., Eccles, D. W., & Barraux, E. (2012). What makes an orienteer an expert? A case study of a highly elite orienteer's concerns in the course of competition. *Journal of Sports Sciences, 30*(1), 91-99. https://doi.org/10.1080/02640414.2011.617774

Marr, D. S. (2011). Care of the multisport athlete: Lessons from Goldilocks. *British Journal of Sports Medicine, 45*, 1.

Matsangidou, M., Ang, C. S., Mauger, A. R., Intarasirisawat, J., Otkhmezuri, B., & Avraamides, M. N. (2019). Is your virtual self as sensational as your real? Virtual reality: The effect of body consciousness on the experience of exercise sensations.

*Psychology of Sport & Exercise, 41*, 218–224.

https://doi.org/10.1016/j.psychsport.2018.07.004

Mauger, A. R., Jones, A. M., & Williams, C. A. (2016). Influence of exercise variation on the

retention of a pacing strategy. *European Journal of Applied Physiology, 106*(3), 383-

391. https://doi.org/10.1007/s00421-009-1036-3

Maughan, R. J., & Shirrefs, S. M. (2019). Muscle cramping during exercise: Causes,

solutions, and questions remaining. *Sports Medicine, 49*, S115–S124.

https://doi.org/10.1007/s40279-019-01162-1

Maw, G. (2019). Effective performance support: An integrated view. In D. Collins, A.

Cruickshank, & G. Jordet (Eds.), *Routledge handbook of elite sport performance* (1st

ed., pp. 161–168). Routledge. https://doi.org/10.4324/9781315266343

Mayer, J., Giel, K. E., Malcolm, D., Schneider, S., Diehl, K., Zipfel, S., & Thiel, A. (2018).

Compete or rest? Willingness to compete hurt among adolescent elite athletes.

*Psychology of Sport & Exercise*, *35*, 143–150.

https://doi.org/10.1016/j.psychsport.2017.11.016

Mayer, J., & Thiel, A. (2018). Presenteeism in the elite sports workplace: The willingness to

compete hurt among German elite handball and track and field athletes. *International

Review for the Sociology of Sport*, *53*(1), 49–68.

https://doi.org/10.1177/1012690216640525

McCardle, L., Young, B. W., & Baker, J. (2019). Self-regulated learning and expertise

development in sport: Current status, challenges, and future opportunities.

*International Review of Sport and Exercise Psychology, 12*(1), 112-138.

https://doi.org/10.1080/1750984X.2017.1381141

McCormick, A., Meijen, C., & Marcora, S. (2018a). Effects of a motivational self-talk intervention for endurance athletes completing an ultramarathon. *The Sport Psychologist, 32*(1), 42-50. https://doi.org/10.1123/tsp.2017-0018

McCormick, A., Meijen, C., & Marcora, S. (2018b). Psychological demands experienced by recreational endurance athletes. *International Journal of Sport and Exercise Psychology, 16*, 415-430. https://doi.org/10.1080/1612197X.2016.1256341

McCormick, A., Meijen, C., Anstiss, P. A., & Jones, H. S. (2019). Self-regulation in endurance sports: Theory, research, and practice. *International Review of Sport and Exercise Psychology, 12*, 235-264. https://doi.org/10.1080/1750984X.2018.1469161

McGannon, K. R., & Schweinbenz, A. N. (2011). Traversing the qualitative–quantitative divide using mixed methods: Some reflections and reconciliations for sport and exercise psychology. *Qualitative Research in Sport, Exercise and Health, 3*(3), 370-384. https://doi.org/10.1080/2159676X.2011.607187

McGannon, K. R., & Smith, B. (2015). Centralizing culture in cultural sport psychology research: The potential of narrative inquiry and discursive psychology. *Psychology of Sport and Exercise, 17*, 79-87. https://doi.org/10.1016/j.psychsport.2014.07.010

McGee, S., Kerr, G., Atkinson, M., & Stirling, A. (2024). "I always just viewed it as part of sport": Psychological maltreatment and conformity to the sport ethic. *Journal of Applied Sport Psychology*, *37*(4), 487–506. https://doi.org/10.1080/10413200.2024.2414002

McGee, S., Atkinson, M., & Stirling, A. (2025). Winning-at-all-costs: high-performance athletes learn to conform to the sport ethic. *Sport, Education and Society*, 1–15. https://doi.org/10.1080/13573322.2025.2461616

McGreary, M., Birch, P., Eubank, M., & Whitehead, A. (2020). Thinking aloud: A qualitative analysis of stressors and coping responses in cricket bowlers during a competitive

match. *Qualitative Research in Sport, Exercise and Health, 14*(3), 426-442.

https://doi.org/10.1080/2159676X.2020.1829013

McGreary, S., Vaughan, S., Swettenham, L., & Whitehead, A. (2024). Think-aloud protocol
as a research method in sport psychology: Advantages, challenges, and future
directions. *International Review of Sport and Exercise Psychology, 17*(1), 124-143.

https://doi.org/10.1080/1750984X.2023.2217848

McGreary, M., Vaughan, S., Swettenham, L., & Whitehead, A. (2025). Considerations For
the Use of Think-aloud Within Self-Talk Research. In J. Thibodeaux, J. L. Van
Raalte, & Y. L. Dickens (Eds.), *Principles of self-talk in sport settings: Theory,
research, and practice* (pp. 91–103). American Psychological Association.

https://doi.org/10.1037/0000434-006

McNarry, G., Allen-Collinson, J., & Evans, A. B. (2020). 'You always wanna be sore,
because then you are seeing results': Novel insights into lived experiences of 'positive
pain' in competitive swimming. *Sociology of Sport Journal*, *37*(4), 301–309.

https://doi.org/10.1123/ssj.2019-0133

McNarry, G., Allen-Collinson, J., & Evans, A. B. (2021). 'Ploughing on': A sociological
investigation of 'endurance work' in competitive swimming and distance-running.
*Qualitative Research in Sport, Exercise and Health, 13*(6), 1095-1111.

https://doi.org/10.1080/2159676X.2020.1772859

Meeusen, R., Duclos, M., Foster, C., Fry, A., Gleeson, M., Nieman, D., Raglin, J., Rietjens,
G., Steinacker, J., & Urhausen, A. (2013). Prevention, diagnosis, and treatment of the
overtraining syndrome: Joint consensus statement of the European College of Sport
Science and the American College of Sports Medicine. *Medicine & Science in Sports
& Exercise, 45*(1), 186-205. https://doi.org/10.1249/MSS.0b013e318279a10a

Meijen, C. (Ed.). (2019). *Endurance performance in sport: Psychological theory and interventions*. Routledge.

Meijen, C., Day, C., & Hays, K. F. (2017). Running a psyching team: Providing mental support at long-distance running events. *Journal of Sport Psychology in Action, 8*(1), 12-22. https://doi.org/10.1080/21520704.2016.1205697

Mellick, M. C., & Fleming, S. (2010). Personal narrative and the ethics of disclosure: A case study from elite sport. *Qualitative Research, 10*(3), 299–314. https://doi.org/10.1177/1468794110362873

Melzack, R. (1975). The McGill Pain Questionnaire: Major properties and scoring methods. *Pain, 1*(3), 277-299. https://doi.org/10.1016/0304-3959(75)90044-5

Melzack, R. (1987). The short-form McGill Pain Questionnaire. *Pain, 30*, 191-197.

Melzack, R. (2001). Pain and the neuromatrix in the brain. *Journal of Dental Education, 65*, 1378-1382. https://doi.org/10.1002/j.0022-0337.2001.65.12.tb03497.x

Melzack, R. (2005). The McGill Pain Questionnaire. *American Society of Anesthesiologists, 103*, 199-202.

Melzack, R., & Casey, K. L. (1968). Sensory, motivational, and central control determinants of pain: A new conceptual model. In D. Kenshalo (Ed.), *The skin senses* (pp. 423-443). Springfield.

Melzack, R., & Katz, J. (2012). The Gate Control Theory: Reaching for the brain. In T. Hadjistavropoulos & K. D. Craig (Eds.), *Pain psychological perspectives* (pp. 13-34). Psychology Press.

Merleau-Ponty, M. (2001). *Phenomenology of perception* (C. Smith, Trans.). Routledge & Kegan Paul. (Original work published 1945)

Meyers, M. C., Bourgeois, A. E., Stewart, S., & LeUnes, A. (1992). Predicting pain response in athletes: Development and assessment of the Sports Inventory for Pain. *Journal of Sport & Exercise Psychology, 14*, 249-261.

Miles, K. H., Clark, B., Fowler, P. M., Miller, J., & Pumpa, K. L. (2019). Sleep practices implemented by team sport coaches and sports science support staff: A potential avenue to improve athlete sleep? *Journal of Science and Medicine in Sport, 22*(7), 748-752. https://doi.org/10.1016/j.jsams.2019.01.008

Mogil, J. S., & Bailey, A. L. (2024). Gendered pain: A call for recognition and health equity [Editorial]. *EClinicalMedicine*, *69*, Article 102558. https://doi.org/10.1016/j.eclinm.2024.102558

Mogil, J. S., Pogatzki-Zahn, E. M., Roche, M., & Vincent, K. (2024). *Biological mechanisms underlying sex differences in pain* [Fact sheet]. International Association for the Study of Pain. https://www.iasp-pain.org/resources/fact-sheets/

Mon-López, D., García-Aliaga, A., Ginés Bartolomé, A., & Muriarte Solana, D. (2020). How has COVID-19 modified training and mood in professional and non-professional football players? *Physiology & Behaviour, 227*, 113148. https://doi.org/10.1016/j.physbeh.2020.113148

Moore, P. (2019). Supporting performance: A national institute perspective. In D. Collins, A. Cruickshank, & G. Jordet (Eds.), *Routledge handbook of elite sport performance* (1st ed., pp. 225–234). Routledge. https://doi.org/10.4324/9781315266343

Morgan, W. P. (1980). Test of champions: The iceberg profile. *Psychology Today, 14*, 92-108.

Morgan, W. P., O'Connor, P. J., Sparling, P. B., & Pate, R. R. (1987). Psychological characterisation of the elite female distance runner. *International Journal of Sports Medicine, 8*, 124-131.

Morgan, W. P., & Pollock, M. L. (1977). Psychological characterisation of the elite distance runner. *Annals of the New York Academy of Sciences, 301*, 382-403.

Moseley, I. G., & Arntz, A. (2007). The context of a noxious stimulus affects the pain it evokes. *Pain, 133*, 64-71. http://dx.doi.org/10.1016/j.pain.2007.03.002

Neale, B. (2025). Q*ualitative longitudinal research: Research Methods.* (2nd ed.). Bloomsbury Research Methods, NCRM.

Nicolas, M., Banizette, M., & Millet, G. Y. (2011). Stress and recovery states after a 24h ultra-marathon race: A one-month follow-up study. *Psychology of Sport and Exercise, 12*(4), 368-374. https://doi.org/10.1016/j.psychsport.2011.03.005

Nixon, H. L. (1993). Accepting the risks of pain and injury in sport: Mediated cultural influences on playing hurt. *Sociology of Sport Journal*, *10*(2), 183–196. https://doi.org/10.1123/ssj.10.2.183

Nizza, I. E., Farr, J., & Smith, J. A. (2021). Achieving excellence in interpretative phenomenological analysis (IPA): Four markers of high quality. *Qualitative Research in Psychology, 18*(3), 369-386. https://doi.org/10.1080/14780887.2020.1854404

Olive, R. & Thorpe, H. (2011). Negotiating the "F-Word" in the field: Doing feminist ethnography in action sports cultures. *Sociology of Sport Journal, 28*(4), 421–440.

Oliver, E. J., Hardy, J., & Markland, D. (2021). Identifying important practice behaviours for the development of high-level youth athletes: Exploring the perspectives of elite coaches. *Psychology of Sport and Exercise, 27*, 101830. https://doi.org/10.1016/j.psychsport.2020.101830

Onwuegbuzie, A. J., & Leech, N. L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology, 8*, 375-387. https://doi.org/10.1080/13645570500402447

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, *13*(1), 48-63.

Otter, R.T.A., Brink, M. S., Diercks, R. L., & Lemmink, K. A. P. M. (2016) A negative life event impairs psychosocial stress, recovery and running economy of runners. *International Journal of Sports Medicine, 37*(3), 224–229. https://doi.org/10.1055/s-0035-1555932

Overbye, M. (2021). Walking the line? An investigation into elite athletes' sport-related use of painkillers and their willingness to use analgesics to train or compete when injured. *International Review for the Sociology of Sport, 56*(8), 1091–1115. https://doi.org/10.1177/1012690220973552

Palermo, T. M. (2020). Pain prevention and management must begin in childhood: The key role of psychological interventions. *Pain, 161*, S114-S121. http://dx.doi.org/10.1097/j.pain.0000000000001862

Paley, C. A., & Johnson, M. I. (2025). Human resilience and pain coping strategies: A review of the literature giving insights from elite ultra-endurance athletes for sports science, medicine and society. *Sports Medicine*. Advance online publication. https://doi.org/10.1007/s40279-025-02277-4

Palmer, C. (2016). Ethics in sport and exercise research: From research ethics committees to ethics in the field. In B. Smith & A. C. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and exercise* (pp. 316–329). Routledge.

Parkins, E., Meyers, M., Robinson, S., Mitton, J., & Bullers, A. (2024). Athletic and pain coping skills of female ultra runners. *Medicine & Science in Sports & Exercise, 56*(5), 135-135. https://doi.org/10.1249/01.mss.0001053672.53785.96

Parsons-Smith, R. L., Barkase, S., Lovell, G. P., Vleck, V., & Terry, P. C. (2022). Mood

profiles of amateur triathletes: Implications for mental health and performance.

*Frontiers in Psychology, 13*, 925992. https://doi.org/10.3389/fpsyg.2022.925992

Parsons-Smith, R. L., Terry, P. C., & Machin, M. A. (2017). Identification and description of

novel mood profile clusters. *Frontiers in Psychology, 8*, 1958.

https://doi.org/10.3389/fpsyg.2017.01958

Paul, R. W., Sonnier, J. H., Johnson, E. E., Warnock, N. L., & Delanois, R. E. (2022).

Inequalities in the evaluation of male versus female athletes in sports medicine

research: A systematic review. *American Journal of Sports Medicine*, *50*(14), 3968–

3974. https://doi.org/10.1177/03635465221131281

Paul, D. J., Jones, L., & Read, P. (2022). Shared decision-making: Some cautionary

observations in the context of elite sport. *Sports Medicine-Open, 8*(1), 44.

https://doi.org/10.1186/s40798-022-00413-2

Descartes, R. (1664). *Traité de l'homme*. Paris: Angot in Payne, S., & Horn, S. (Eds.) (1997).

*Pain: Theory, research, and intervention*. Open University Press.

Payne, S., & Horn, S. (Eds.) (1997). *Pain: Theory, research, and intervention*. Open

University Press.

Peacock, S., & Patel, S. (2008). Cultural influences on pain. *Reviews in Pain, 1*(2), 6-9.

https://doi.org/10.1177/204946370800100203

Pensgaard, A. M., Ivarsson, A., Nilstad, A., Solstad, B. E., Steffen, K., & Bahr, R. (2018).

Psychosocial stress factors, including the relationship with the coach, and their

influence on acute and overuse injury risk in elite female football players. *BMJ Open

Sport & Exercise Medicine, 4*(1), e000317. https://doi.org/10.1136/bmjsem-2017-

000317

Pettersen, S. A., Neubauer, D. N., & Haraldsdottir, K. (2020). The physiological response of female elite ultramarathon runners to multi-day training in hot climate. *International Journal of Environmental Research and Public Health, 17*(16), 5824. https://doi.org/10.3390/ijerph17165824

Pettersen, S. D., Aslaksen, P. M., & Pettersen, S. A. (2020). Pain processing in elite and high-level athletes compared to non-athletes. *Frontiers in Psychology, 11*, 1908. https://doi.org/10.3389/fpsyg.2020.01908

Phillippe, R. A. & Seiler, R. (2005). Sex differences on use of associative and dissociative cognitive strategies among male and female athletes. *Perceptual and Motor Skills, 101*, 440-444.

Plano Clark, V. L., Anderson, N., Wertz, J. A., Zhou, Y., Schumacher, K., & Miaskowski, C. (2015). Conceptualising longitudinal mixed methods designs: A methodological review of health sciences research. *Journal of Mixed Methods Research, 9*, 297-319. https://doi.org/10.1177/1558689814543563

Polenske, A. D., Clancy, R. B., Smith, L. R., Dicks, N. D., & Michel, J. (2022). Coping skills of NCAA Division I field athletes. *Journal of Sport Behaviour, 45*(3), 61–74.

Polley, M. (2014). Sport, gender, and sexuality at the 1908 London Olympic Games. In J. Hargreaves & E. Anderson (Eds.), *Routledge handbook of sport, gender, and sexuality*. Taylor and Francis Group.

Poth, C. N. (2018). *Innovation in mixed methods research: A practical guide to integrative thinking with complexity*. SAGE Publications.

Price, D. D. (1999). *Psychological mechanisms of pain and analgesia*. IASP Press.

Price, D. D., Bush, F. M., Long, S., & Harkins, S. W. (1994). A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. *Pain, 56*, 217-226.

Professional Triathletes Organisation. (2023). About the PTO World Ranking System. https://protriathletes.org/pto-world-ranking-system

Racine, M., Tousignant-Laflamme, Y., Kloda, L. A., Dion, D., Dupuis, G., & Choinière, M. (2012). A systematic literature review of 10 years of research on sex/gender and pain perception – Part 2: Do biopsychosocial factors alter pain sensitivity differently in women and men? *Pain*, *153*(3), 619–635. https://doi.org/10.1016/j.pain.2011.11.026

Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., Keefe, F. J., Mogil, J. S., Ringkamp, M., Sluka, K. A., Song, X. J., Stevens, B., Sullivan, M. D., Tutelman, P. R., Ushida, T., & Vader, K. (2020). The revised International Association for the Study of Pain definition of pain: Concepts, challenges, and compromises. *Pain, 161*(9), 1976-1982. https://doi.org/10.1097/j.pain.0000000000001939

Rees, T., & Hardy, L. (2000). An investigation of the social support experiences of high-level sports performers. *The Sport Psychologist*, *14*(4), 327–347. https://doi.org/10.1123/tsp.14.4.327

Renaud, G., & Napier, C. (2023). Narrowing the gap. *British Journal of Sports Medicine*, *57*(5), 249–250. https://doi.org/10.1136/bjsports-2022-105899

Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology, 11*, 25-41. https://doi.org/10.1080/14780887.2013.801543

Rochat, N., Gesbert, V., Seifert, L., & Hauw, D. (2018). Enacting phenomenological gestalts in ultra-trail running: An inductive analysis of trail runners' courses of experience. *Frontiers in Psychology, 9*, 2038. https://doi.org/10.3389/fpsyg.2018.02038

Roderick, M., Waddington, I., & Parker, G. (2000). Playing hurt: Managing injuries in

English professional football. *International Review for the Sociology of Sport, 35*(2),

165–180. https://doi.org/10.1177/101269000035002003

Roderick, M. (2006). Adding insult to injury: Workplace injury in English professional

football. *Sociology of Health & Illness, 28*(1), 76–97. https://doi.org/10.1111/j.1467-

9566.2006.00483.x

Roebuck, G. S., Fitzgerald, P. B., Urquhart, D. M., Ng, S-K., Cicuttini, F. M., & Fitzgibbon,

B. M. (2018). The psychology of ultra-marathon runners: A systematic review.

*Psychology of Sport and Exercise, 37*, 43-58.

https://doi.org/10.1016/j.psychsport.2018.04.004

Roebuck, G. S., Urquhart, D. M., Che, X., Knox, L., Fitzgerald, P. B., Cicuttini, F. M., Lee,

S., Segrave, R., & Fitzgibbon, B. M. (2020). Psychological characteristics associated

with ultra-marathon running: An exploratory self-report and psychophysiological

study. *Australian Journal of Psychology, 72*, 235-247.

https://doi.org/10.1111/ajpy.12287

Roessler, K. K. (2006). Sport and the psychology of pain. In S. Loland, B. Skirstad, & I.

Waddington (Eds.), *Pain and sport injury: Social and ethical analysis* (pp. 34-47).

Routledge.

Rogger, R., Bello, C., Romero, C. S., Urman, R. D., Luedi, M. M., & Filipovic, M. G. (2023).

Cultural framing and the impact on acute pain and pain services. *Current Pain and

Headache Reports, 27(*8), 429-436. https://doi.org/10.1007/s11916-023-01125-2

Ronkainen, N. J., Ryba, T. V., & Nesti, M. S. (2013). The engine does not inevitably break

down: Aging and identity in masters sport. *Sport in Society, 16*(10), 1304-1322.

https://doi.org/10.1080/17430437.2013.821256

Ronkainen, N. J., Allen-Collinson, J., Aggerholm, K., & Ryba, T. V. (2020). Superwomen? Young sporting women, temporality and learning not to be perfect. *International Review for the Sociology of Sport*, *56*(8), 1137-1153. https://doi.org/10.1177/1012690220979710 (Original work published 2021)

Rushall, B. S., Hall, M., Roux, L., Sasseville, J., & Rushall, A. C. (1988). Effects of three types of thought content instructions on skiing performance. *The Sport Psychologist, 2*(4), 283-297. https://doi.org/10.1123/tsp.2.4.283

Rüst, C. A., Rosemann, T., & Knechtle, B. (2014). Performance and sex difference in ultra-triathlon performance from Ironman to Double Deca Iron ultra-triathlon between 1978 and 2013. *SpringerPlus*, *3*, Article 219. https://doi.org/10.1186/2193-1801-3-219

Salma, C. L., & Meyers, M. C. (2019). Athletic and pain coping skills of competitive female equestrian athletes. *Journal of Sport Behaviour, 42*(1), 91–108.

Salmons, J. (2015). *Qualitative online interviews.* London: Sage.

Salwin, E., & Zajac, A. (2016). Pain tolerance in sport. *Journal of Human Kinetics, 53*(1), 113-124. https://doi.org/10.1515/hukin-2016-0014

Samson, A., Simpson, D., Kamphoff, C., & Langlier, A. (2017). Think-aloud: An examination of distance runners' thought processes. *International Journal of Sport and Exercise Psychology, 15*, 176-189. https://doi.org/10.1080/1612197X.2015.1069877

Samuel, R. D., & Tenenbaum, G. (2011). How do athletes perceive and respond to change events: An exploratory measurement tool. *Psychology of Sport and Exercise, 12*(4), 392-406.

Samulowitz, A., Gremyr, I., Eriksson, E., & Hensing, G. (2018). "Brave men" and "emotional women": A theory-guided literature review on gender bias in health care

and gendered norms towards patients with chronic pain. *Pain Research and Management*, 2018, Article ID 6358624. https://doi.org/10.1155/2018/6358624

Sanders, P., & Winter, S. (2016). Going pro: Exploring adult triathletes' transitions into elite sport. *Sport, Exercise, and Performance Psychology, 5*(1), 193-205. https://doi.org/10.1037/spy0000059

Saw, A. E., Main, L. C., & Gastin, P. B. (2015). Monitoring the athlete training response: Subjective self-reported measures trump commonly used objective measures: A systematic review. *British Journal of Sports Medicine, 49*(5), 287-291. https://doi.org/10.1136/bjsports-2014-093494

Schaal, K., Tafflet, M., Nassif, H., Thibault, V., Pichard, C., Alcotte, M., Guillet, T., El Helou, N., Berthelot, G., Simon, S., & Toussaint, J.-F. (2011). Psychological balance in high level athletes: Gender-based differences and sport-specific patterns. *PLoS ONE, 6*(5), e19007. https://doi.org/10.1371/journal.pone.0019007

Schinke, R. J., & McGannon, K. R. (2014). The acculturation experiences of (and with) immigrant athletes. *International Journal of Sport and Exercise Psychology*, *12*(1), 64–75. https://doi.org/10.1080/1612197X.2013.785093

Schinke, R. J., Stambulova, N. B., Si, G., & Moore, Z. (2018). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology, 16*(6), 622-639. https://doi.org/10.1080/1612197X.2017.1295557

Schnell, A., Mayer, J., Diehl, K., Zipfel, S., & Thiel, A. (2014). Giving everything for athletic success!–Sports-specific risk acceptance of elite adolescent athletes. *Psychology of Sport and Exercise, 15*(2), 165–172. https://doi.org/10.1016/j.psychsport.2013.10.012

Schneider, T. A., Butryn, T. M., Furst, D. M., & Masucci, M. A. (2007). A qualitative examination of risk factors among elite female triathletes. *Journal of Sport Behaviour, 30*(2), 158-175.

Schubring, A., & Thiel, A. (2014). Coping with growth in adolescent elite sport. *Sociology of Sport Journal, 31*(3), 304–326. https://doi.org/10.1123/ssj.2013-0071

Schubring, A., Halltén, M., Barker-Ruchti, N., & Post, A. (2023). Balancing risk-taking and self-care: The ecology of athlete health behaviour during the Olympic qualification phase. *International Review for the Sociology of Sport, 58*(8), 1326–1348. https://doi.org/10.1177/10126902231168098

Schücker, L., Hagemann, N., Strauss, B., & Völker, K. (2014). The effect of attentional focus on running economy. *Journal of Sports Sciences, 32*(15), 1482-1495. https://doi.org/10.1080/02640414.2014.912458

Schuler, J., Wolff, D., & Hofmann, F. (2018). Exercise addiction: A case report and literature review. *Psychology of Sport and Exercise, 38*, 277-281. https://doi.org/10.1016/j.psychsport.2018.06.005

Schultz, K., Simmens, S. J., & Lipman, G. S. (2012). Wilderness medical society practice guidelines for the prevention and treatment of heat-related illness. *Wilderness & Environmental Medicine, 23*(1), 76-81. https://doi.org/10.1016/j.wem.2011.10.008

Schutz, U. H. W., Schmidt-Trucksäss, A., Knechtle, B., Machann, J., Wiedelbach, H., Ehrhardt, M., Freund, W., Gröninger, S., Brunner, H., Schulze, I., Brambs, H-J., & Billich, C. (2012). The Transeurope Footrace Project: Longitudinal data acquisition in a cluster randomized mobile MRI observational cohort study on 44 endurance runners at a 64-stage 4,486km transcontinental ultramarathon. *BMC Medicine, 10*, 1-33. https://doi.org/10.1186/1741-7015-10-78

ShandaHill. (2024). ShandaHill UltraAthlete [Facebook page]. Facebook. Retrieved October

    12, 2024 from https://www.facebook.com/ShandaHillUltraAthlete/

Shipherd, A. M., Renner, K. B., Samson, A., & Duncan, C. K. (2021). An examination of the

    sources of self-efficacy in runners throughout training: A mixed methods study.

    *Journal of Sport Behaviour, 44*, 141-164.

Shipway, R., & Holloway, I. (2010). Running free: Embracing a healthy lifestyle through

    distance running. *Perspectives in Public Health, 130*, 270–276.

    https://doi.org/10.1177/1757913910379191

Sigg, K., Knechtle, B., Rüst, C. A., Knechtle, P., Lepers, R., & Rosemann, T. (2013). Sex

    difference in Double Iron ultra-triathlon performance. *Extreme Physiology &*

    *Medicine*, *2*, Article 12. https://doi.org/10.1186/2046-7648-2-12

Silva, J. M., & Appelbaum, M. I. (1989). Association-dissociation patterns of United States

    Olympic marathon trial contestants. *Cognitive Therapy and Research, 13*, 185-192.

Simpson, D., Post, P. G., Young, G., & Jensen, P. R. (2014). "It's not about taking the easy

    road": The experiences of ultramarathon runners. *The Sport Psychologist, 28*, 176-

    185. http://dx.doi.org/10.1123/tsp.2013-0064

Sitko, S., López-Laval, I., Cirer-Sastre, R., & Valenzuela, P. L. (2025). Ultra-endurance

    performance: Are women closing the gap? A systematic review and meta-analysis.

    *International Journal of Sports Science & Coaching*. Advance online publication.

    https://doi.org/10.1177/17479541251354909

Sleivert, G. G., & Rowlands, D. S. (2000). Physical and physiological factors associated with

    success in the triathlon. *Sports Medicine, 22*(1), 8-18.

    https://doi.org/10.2165/00007256-199622010-00002

Slepian, P. M., French, D. J., Evans, R. T., Payne, H. A., & Pousette, M. W. (2020). The

    relationship between resilience, pain catastrophising, and psychological distress in

chronic pain. *Journal of Pain Research, 13*, 3353-3360.

https://doi.org/10.2147/JPR.S267931

Smith, B. (2018). Generalisability in qualitative research: Misunderstandings, opportunities

and recommendations for the sport and exercise sciences. *Qualitative Research in*

*Sport, Exercise and Health, 10*, 137-149.

https://doi.org/10.1080/2159676X.2017.1393221

Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems

and opportunities within sport and exercise psychology. *International Review of Sport*

*and Exercise Psychology, 11*, 101-121.

https://doi.org/10.1080/1750984X.2017.1317357

Smith, B., & Monforte, J. (2020). Stories, new materialism and pluralism: Understanding,

practising and pushing the boundaries of narrative analysis. *Methods in Psychology*, *2*,

Article 100016. https://doi.org/10.1016/j.metip.2020.100016

Smith, E. S., McKay, A. K. A., Ackerman, K. E., Harris, R., Elliott-Sale, K. J., Stellingwerff,

T., & Burke, L. M. (2022). Methodology review: A protocol to audit the

representation of female athletes in sports science and sports medicine research.

*International Journal of Sport Nutrition and Exercise Metabolism*, *32*(2), 114–127.

https://doi.org/10.1123/ijsnem.2021-0257

Smith, J. A. (2011). Evaluating the contribution of interpretative phenomenological analysis.

*Health Psychology Review, 5*, 9-27. https://doi.org/10.1080/17437199.2010.510659

Smith, J. A. (2019). Participants and researchers searching for meaning: Conceptual

developments for interpretative phenomenological analysis. *Qualitative Research in*

*Psychology, 16*, 166–181. https://doi.org/10.1080/14780887.2018.1540648

Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative phenomenological analysis:*

*Theory, method, and research*. Sage.

Smith, J. A., Flowers, P., & Larkin, M. (2022). *Interpretative phenomenological analysis: Theory, method, and research* (2nd ed.). Sage.

Smith, J. A., & Nizza, I. E. (2021). *Essentials of interpretative phenomenological analysis*. American Psychological Association.

Smith, J. A., & Osborn, M. (2015). Interpretative phenomenological analysis as a useful methodology for research on the lived experience of pain. *British Journal of Pain, 9*, 41–42. https://doi.org/10.1177/2049463714541642

Sparkes, A. C., & Smith, B. (2014). *Qualitative research methods in sport, exercise, and health: From process to product*. Routledge.

St Clair Gibson, A., & Foster, C. (2007). The role of self-talk in the awareness of physiological state and physical performance. *Sports Medicine, 37*(12), 1029-1044. https://doi.org/10.2165/00007256-200737120-00003

Stambulova, N. B. (2000). Athlete's crises: A developmental perspective. *International Journal of Sport Psychology, 31*, 584–601.

Stambulova, N. B. (2003). Symptoms of a crisis transition: A grounded theory study. In M. Hassmén (Ed.), *SIPF yearbook 2003* (pp. 97–109). Örebro University Press.

Stambulova, N. B. (2009). Talent development in sport: A career transition perspective. In E. Tsung-Min Hung, R. Lidor, & D. Hackfort (Eds.), *Psychology of sport excellence* (pp. 63–74). Fitness Information Technology.

Stambulova, N. B. (2016). Athletes' transitions in sport and life: Positioning new research trends within existing system of athlete career knowledge. In R. J. Schinke, K. McGannon, & B. Smith (Eds.), *The Routledge international handbook of sport psychology* (pp. 519–535). Routledge.

Stambulova, N., & Henriksen, K. (2025). Career transitions in sport: Bridging holistic

    developmental and ecological approaches. *Psychology of Sport & Exercise*, *80*,

    Article 102900. https://doi.org/10.1016/j.psychsport.2025.102900

Stoeber, J., & Janssen, D. P. (2011). Perfectionism and coping with daily failures: Positive

    reframing helps achieve satisfaction at the end of the day. *Anxiety, Stress, & Coping,*

    *24*(5), 477-497. https://doi.org/10.1080/10615806.2011.562977

Strand, L. I., Ljunggren, A. E., Bogen, B., Ask, T., & Johnsen, T. B. (2008). The Short-Form

    McGill Pain Questionnaire as an outcome measure: Test–retest reliability and

    responsiveness to change. *European Journal of Pain, 12*(7), 917-925.

    https://doi.org/10.1016/j.ejpain.2007.12.013

Sullivan, M. J., Tripp, D. A., Rodgers, W. M., & Stanish, W. (2000). Catastrophising and

    pain perception in sport participants. *Journal of Applied Sport Psychology, 12*, 151–

    167. https://doi.org/10.1080/10413200008404220

Swann, C., Crust, L., Keegan, R., Piggott, D., & Hemmings, B. (2015). An inductive

    exploration into the flow experiences of European Tour golfers. *Qualitative Research*

    *in Sport, Exercise and Health, 7(*2), 210–234.

    https://doi.org/10.1080/2159676X.2014.926969

Tait, R. C., Chibnall, J. T., & Krause, S. (1990). The Pain Disability Index: Psychometric

    properties. *Pain, 40*, 171-182.

Tammen, V. V. (1996). Elite middle and long distance runners associative/dissociative

    coping. *Journal of Applied Sport Psychology, 8*, 1-8.

Tamminem, K. A., Holt, N. L., & Neely, K. C. (2013). Exploring adversity and the potential

    for growth among elite female athletes. *Psychology of Sport and Exercise, 14*(1), 28-

    36.

Temme, K. E., & Hoch, A. Z. (2013). Recognition and rehabilitation of the female athlete triad/tetrad: A multidisciplinary approach. *Current Sports Medicine Reports, 12*(3), 190-199.

Tenenbaum, G., Fogarty, G., Stewart, E., Calcagnini, N., Kirker, B., Thorne, G., & Christensen, S. (1999). Perceived discomfort in running: Scale development and theoretical considerations. *Journal of Sports Sciences, 17*(3), 183-196.

Terry, G., & Hayfield, N. (2022). Reflexive thematic analysis. In C. Willig & W. Stainton Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 301-323). SAGE Publications.

Terry, P., Lane, A., & Fogarty, G. (2003). Construct validity of the Profile of Mood States—Adolescents for use with adults. *Psychology of Sport and Exercise, 4*, 125–139.

Terry, P. C., & Lane, A. M. (2010). *User guide for the Brunel Mood Scale*. University of Southern Queensland, Australia.

Terry, P. C., & Parsons-Smith, R. L. (2021). Mood profiling for sustainable mental health among athletes. *Sustainability, 13*, 6116. https://doi.org/10.3390/su13116116

Tesarz, J., Schuster, A. K., Hartmann, M., Gerhardt, A., & Eich, W. (2012). Pain perception in athletes compared to normally active controls: A systematic review with meta-analysis. *Pain, 153*(6), 1253-1262. https://doi.org/10.1016/j.pain.2012.03.005

Theberge, N. (2008). "Just a normal bad part of what I do": Elite athletes' accounts of the relationship between health and sport. *Sociology of Sport Journal, 25*(2), 206–222. https://doi.org/10.1123/ssj.25.2.206

Thiel, A., Schubring, A., Schneider, S., Zipfel, S., & Mayer, J. (2015). Health in elite sports—a "bio-psycho-social" perspective. *German Journal of Sports Medicine*, *66*(9), 241–247. https://doi.org/10.5960/dzsm.2015.194

Thompson, J. (2022). A guide to abductive thematic analysis. *The Qualitative Report*, *27*(5), 1410–1421. https://doi.org/10.46743/2160-3715/2022.5340

Thorpe, H. (2014). Moving bodies beyond the social/biological divide: Toward theoretical and transdisciplinary adventures. *Sport, Education and Society, 19*, 666-686.

Thorpe, H., & Clark, M. (2020). Gut feminism, new materialisms and sportswomen's embodied health: The case of RED-S in endurance athletes. *Qualitative Research in Sport, Exercise and Health, 12*, 1-17.
https://doi.org/10.1080/2159676X.2019.1631879

Throsby, K. (2013). 'If I go in like a cranky sea lion, I come out like a smiling dolphin': Marathon swimming and the unexpected pleasures of being a body in water. *Feminist Review, 103*, 5-22.

Thuany, M., Gomes, T. N., Weiss, K., Knechtle, B., Rolim, R., & Moura dos Santos, M. A. (2023). Beyond the border of the athlete-centred approach: A model to understand runners' performance. *Frontiers in Psychology, 14*, 1137023.
https://doi.org/10.3389/fpsyg.2023.1137023

Tibbert, S. J., Andersen, M. B., & Morris, T. (2015). What a difference a "Mentally Toughening" year makes: The acculturation of a rookie. *Psychology of Sport and Exercise*, *17*, 68–78. https://doi.org/10.1016/j.psychsport.2014.10.007

Tibbert, S. J., & Andersen, M. B. (2015). Overtraining in professional sport: Exceeding the limits in a culture of physical and mental toughness. In J. G. Cremades & L. S. Tashman (Eds.), *Becoming a sport, exercise, and performance psychology professional: A global perspective* (pp. 233-240). Psychology Press.

Tiller, N. B., Elliott-Sale, K. J., Knechtle, B., Wilson, P. B., Roberts, J. D., Millet, G. Y. (2021). Do sex differences in physiology confer a female advantage

in ultra-endurance sport? *Sports Medicine, 51,* 895–915.

https://doi.org/10.1007/s40279-020-01417-2

Tuffey, S. (2000). Psychological preparation of endurance performers. In R. J. Shephard & P. Astrand (Eds.), *The encyclopaedia of sports medicine: Endurance in sport* (Vol. 2, pp. 451-457). Blackwell Science Ltd.

Uvnas-Moberg, K., & Petersson, M. (2005). Oxytocin, a mediator of anti-stress, wellbeing, social interaction, growth and healing. *Zeitschrift für Psychosomatische Medizin und Psychotherapie, 51*(1), 57-80. https://doi.org/10.13109/zptm.2005.51.1.57

Vallerand, R. J. (2012). The role of passion in sustainable psychological wellbeing. *Psychology of Wellbeing: Theory, Research and Practice, 2*, 1-21. https://doi.org/10.1186/2211-1522-2-1

Van Raalte, J., Brennan, M. R., Cornelius A., & Brewer, B. W. (2015). Self-talk of marathon runners. *The Sport Psychologist, 29*, 258-260.

Vaughan, S., McEwan, H. E., Beggan, A., & Whitehead, A. E. (2025). Tales from the peloton: Stress and coping in professional women's road cycling. *Psychology of Sport & Exercise*, *79*, Article 102876. https://doi.org/10.1016/j.psychsport.2025.102876

Venhorst, A., Micklewright, D., & Noakes, T. D. (2018). Towards a three-dimensional framework of centrally regulated and goal-directed exercise behaviour: A narrative review. *British Journal of Sports Medicine, 52*, 957–966.

Vicary, S., Young, A., & Hicks, S. (2017). A reflective journal as learning process and contribution to quality and validity in interpretative phenomenological analysis. *Qualitative Social Work, 16*, 550–565. https://doi.org/10.1177/1473325016635244

Vinokur, A., Oksenberg, L., & Cannell, C. F. (1979). Effects of feedback and reinforcement on the report of health information. In C. F. Cannell, L. Oksenberg, & J. M. Converse (Eds.), *Experiments in interviewing techniques*. University of Michigan.

Vleck, V. E., Bentley, D. J., Millet, G. P., & Bürgi, A. (2014). Triathlon event distance specialisation: Training and injury effects. *Journal of Strength and Conditioning Research, 24*(1), 30-36. https://doi.org/10.1519/JSC.0b013e3181bd4393

Vijayan, R. (2010). Ethics in pain medicine. In S. L. Tsui, P. P. Chen, & K. F. J. Ng (Eds.), Pain medicine (pp. 81–91). Hong Kong University Press.

Waddington, I., & Roderick, M. (2002). Management of medical confidentiality in English professional football clubs: Some ethical problems and issues. *British Journal of Sports Medicine, 36*(2), 118–123. https://doi.org/10.1136/bjsm.36.2.118

Waldvogel, K. J., Nikolaidis, P. T., Di Gangi, S., Rosemann, T., & Knechtle, B. (2019). Women reduce the performance difference to men with increasing age in ultra-marathon running. *International Journal of Environmental Research and Public Health, 16*(13), 2377. https://doi.org/10.3390/ijerph16132377

Walsh, T. D., & Leber, B. (1983). Measurement of chronic pain: Visual analogue scales and McGill Melzack Pain questionnaire compared. In J. J. Bonica, U. Lindblom, & A. Iggo (Eds.), *Advances in pain research and therapy 5*. Raven Press.

Wellard, I. (2016). Gendered performances in sport: An embodied approach. *Palgrave Communications, 2,* 16003. https://doi.org/10.1057/palcomms.2016.3

Whitehead, A. E., Jones, H. S., Williams, E. L., Rowley, C., Quayle, L., Marchant, D., & Polman, R. C. (2018). Investigating the relationship between cognitions, pacing strategies and performance in 16.1 km cycling time trials using a think-aloud protocol. *Psychology of Sport and Exercise, 34*, 95-109. http://dx.doi.org/10.1016/j.psychsport.2017.10.001

Whitehead, A. E., Jones, H. S., Williams, E. L., Dowling, C., Morley, D., Taylor, J. A., & Polman, R. C. (2019). Changes in cognition over a 16.1 km cycling time trial using a think aloud protocol: Preliminary evidence. *International Journal of Sport and*

*Exercise Psychology, 19*(2), 192-202.

https://doi.org/10.1080/1612197X.2019.1708781

Whitehead, A., Montgomery, C., Swettenham, L., & Robinson, N. J. (2022). The effect of think-aloud on performance and brain oxygenation during cycling -- An exploratory study. *Perceptual and Motor Skills, 129*(4), 1115–1136.

https://doi.org/10.1177/00315125221104769

Whitton, O. M., Bowtell, J., & Jones, M. (2020). A critical consideration of the role of mental toughness and pain in the acute pain experiences of athletes. *International Review of Sport and Exercise Psychology, 13*(1), 164-185.

https://doi.org/10.1080/1750984X.2020.1836672

Wiese-Bjornstal, D. M. (2010). Psychology and socioculture affect injury risk, response, and recovery in high-intensity athletes: A consensus statement. *Scandinavian Journal of Medicine & Science in Sports, 20*(Suppl 2), 103–111. https://doi.org/10.1111/j.1600-0838.2010.01195.x

Williams, J. (2019, August 6). Fiona Kolbinger becomes first woman to win ultra-cycling's Transcontinental Race. *BBC Sport*. https://www.bbc.com/sport/cycling/49254835

Wisean Network, (2019)

https://journals.humankinetics.com/view/journals/wspaj/28/1/article-p53.xml

Wright, K. D., Asmundson, G. J. G., & McCreary, D. R. (2001). Factorial validity of the short-form McGill pain questionnaire (SF-MPQ). *European Journal of Pain, 5*(3), 279-284. https://doi.org/10.1053/eujp.2001.0243

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage.

Zaryski, C., & Smith, D. J. (2005). Training principles and issues for ultra-endurance athletes. *Current Sports Medicine Reports, 4*, 165-170. https://doi.org/10.1097/01.CSMR.0000306201.49315.73

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press. https://doi.org/10.1016/B978-012109890-2/50031-7

Zimmerman, B. J. (2001). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 1-37). Lawrence Erlbaum Associates.

Zimmerman, B. J. (2013). From cognitive modelling to self-regulation: A social cognitive career path. *Educational Psychologist, 48*(3), 135-147. https://doi.org/10.1080/00461520.2013.794676

# Appendices

## Appendix A: Ethics approval forms

### *A.1 Study 1 Ethics Approval*



Dear Britta Sorensen,

Re. Exploring perceptions, experiences, and management of pain in ultra-endurance female athletes

Thank you for submitting your ethics application for consideration.

I can confirm that your application has been considered by the SHAS Ethics Committee and that ethical approval is granted. Please find attached your signed approval form.

Yours sincerely,

Jamie North

Faculty of SHAS Ethics Committee

## A.2 Study 2 Ethics Approval

St Mary's
University
Twickenham
London

20 May 2019

Ms. Britta Sorensen

St. Mary's University

Re: A longitudinal case study approach to professional female ultra-triathletes pain management.

Dear Britta,

This letter is to verify that the above titled project is granted ethical approval by the Faculty on behalf of the St. Mary's University Ethics Subcommittee.

Approval is given for completion within the stated time period. If your project does not commence or is not completed within the given time period, please contact your supervisor or a Faculty representative to the Faculty (SHAS) Ethics Committee to ensure that you can continue without resubmitting your application. In addition, any serious adverse events that arise from this study or significant changes that occur in connection with this study and/or which may alter its ethical consideration must be reported to the Faculty Ethics Committee immediately and may require reconsideration of your application.

Approval is given to the understanding that the 'Ethical Guidelines for Research' (see Simms Space) are adhered to. If you have any further questions or need further information, please do not hesitate to get in touch with me.

Yours sincerely

Dr. Peary Brug

Psychology Programme

*A.3 Study 3 Ethics Approval*

St Mary's
University
Twickenham
London

Sport, Allied Health &
Performance Sciences

10/05/2021

Dear Britta,

Re. A case study approach for monitoring race pain and coping experiences of the female

ultra-athlete during naturalistic settings of ultra-events

Thank you for submitting your ethics application for consideration. Your application has

been approved.

Yours sincerely,

Jessica Hill

Faculty of SAHPS Ethics Committee

Index for study 3 appendices:

Appendix 1 A proposed dynamic risk assessment and contingency plan for the field work in

Norway: Appendix 2 Proposed Interview schedule for pre/post event

Appendix 3 Think-aloud protocol for the use of the wristband voice recorder during event by

the athlete and training schedule.

Appendix 4 McGill Pain Questionnaire Short Form (McGill, 1987) and Sport Inventory for

Pain (Meyers et al., 1992)

Appendix 5 Recruitment - example email and advert Appendix

6 Participant Information Form Appendix 7 Informed Consent form Appendix 8 Copy of

First Aid certificate

**Appendix B: Data Collection Materials**

*B.1 Study 1 Interview Guide*

**Primary research question (PRQ):**
How do female ultra-endurance athletes perceive and interpret pain, if at all?
(E.g. pain thresholds/tolerance levels; different types of pain, different situations, injury or exertion-based/race-induced pain)

**Secondary research question (SRQ):**
How do these athletes deal with and cope with their pain?

RESEARCH OBJECTIVES (RO) TO UNCOVER:
1. Unique perception(s) of pain
2. Unique experience(s) of pain
3. Any unique meaning(s) attached to the pain perception and experience
4. Any unique biological, social or psychological influence(s) of pain perception
5. Any unique biological, social or psychological influence(s) of pain experience(s)
6. Any unique biological, social or psychological influence(s) of pain management

**Introductions:**
Rapport with participant – reiterate it will be recorded, and I will make the odd set of notes occasionally. Make sure they feel comfortable; sit at side and use non-verbal communication to engage with them and show I am listening/responding to answers: nodding, eye contact, looking interested, smile.     **STATE THE PARA**

**Notes to self:**
- Give participant time to fully answer questions; SPEAK SLOWLY.
- Use the schedule flexibly
- ACTIVELY Listen to what the participant says and follow up where appropriate
- Empathize in appropriate manner if/where required.

**Proposed Questions and Prompts**

| Question(s) | Prompts/Probing: | Overall aim//PRQ/SRQ/RO's |
|---|---|---|
| 1. Can you tell me a bit about yourself and how you got into your ultra sport? (Narrative question) | Prompt: Can you tell me a bit more about that? Probes: How long have you been doing it? How often and where do you train? How many races? What is it about your sport that keeps you participating in your sport? Which elements do you enjoy the most? What does your sport mean to you? (structural/contrast questions) | To gather background information; rapport building. Ascertaining their motivations, reasons and any influences for taking up the sport. |
| | | |
| 2. Thinking back in time, what's your first significant memory where you remember experiencing any kind of pain? (Narrative question) | Prompt: Can you tell me a bit more about that? Can you recall a time when? What would be an example of? Probe: Nature of the pain? Type? Intensity? Duration? How long did you experience it, and did it ever get repeated? (structural questions) | General - Experiences and Perceptions of pain PRQ RO1-2 |
| | | |
| 3. How would you compare and differentiate any other pain experience(s) since taking up your sport? (Evaluative/contrast question) | Prompt: Can you tell me a bit more about that? How did this compare to the experience described to me previously? Probe: Intensity, duration, nature of it, types, physical/physiological sensations, mental effects? (*NB-actively listen properly to see if plural or single!*). Any environmental factors? Any physiological factors? (structural/contrast questions) | PRQ RO1-2, RO4-5 |
| 4. What would you say your tolerance for pain is like? Can give me any specific examples? (Evaluative question) | Prompt: The threshold would be when you first detect pain and tolerance is how long you can withstand it – what would your self-awareness for these be? Examples in ultra or non-ultra situations? Probe: How self-aware are you of your body and how it feels? | PRQ RO1 RO2 RO5 |

| | How do the environmental factors make a difference such as the heat or cold?<br>Are there ever any situations that change or influence your tolerance levels? E.g. related to times of month, your mood, who you are with, where you are?<br> To what extent have any external or internal factors influenced or shaped how you perceive and tolerate pain?<br>ASK ONLY IF NOT ALREADY GIVEN: Which experiences have shaped your tolerance levels of pain?<br>(comparative/contrast questions) | |
| --- | --- | --- |
| | | |
| 5. What is the difference between discomfort and pain?<br>(Evaluative question) | Prompt: Can you tell me a bit more about that?<br>What's good pain and bad pain?<br>Probe: Relevance of experience, social factors, biological factors, psychological factors e.g. family, friends, coach or teachers?<br>(comparative/contrast questions) | PRQ RO1-2, RO4-5 |
| | | |
| 6. How do you generally decide whether to push through any pain or call it a day?<br>(Evaluative/comparative question) | Prompt: Can you tell me a bit more about that?<br><br>Probe: How may this differ during training or competition? Which key factors influence your decision making? How and when do you decide how serious the pain is or could develop? How does that make a difference, if at all? **Experience and learning**? Are any of these decisions dependent on pain tolerance or thresholds?<br>(comparative/contrast questions) | SRQ RO1-6 |
| | | |
| 7. Are you able to differentiate between injury and exertional pain/race induced muscular pain?<br>(Evaluative question) | Prompt: Can you tell me a bit more about that?<br><br>Probe: Perceived demands/exertion/effort at time of activity? Type of pain? Is there a fear of repeated or long-term injury?<br> (contrast question) | SRQ RO1-6 |
| | | |

| | | |
|---|---|---|
| 8. How do you control your mindset if and when you detect pain or discomfort? (Evaluative/narrative question) (NB DEPENDENT ON PREVIOUS ANSWERS) | Prompt: Can you tell me a bit more about that?<br><br>Probe: How does this differ during training and competition? What influences your decision making? Which management strategies have you developed? (contrast/structural/comparative questions) | SRQ RO4 |
| | | |
| 9. How have your previous experiences and reflections after a race influenced your pain management?<br><br>(Evaluative question) | Prompt: Can you tell me a bit more about that?<br><br>Probe: To what extent have any external or internal factors influenced how you manage your pain levels? To what extent have you been influenced/shaped by any significant others? Which strategies do you use for reflecting on a race and pain management? (comparative/contrast questions) | SRQ RO6 |
| | | |
| 10. Which elements of your pain management strategy could transfer into real life situations outside of sport? (Comparative/evaluative question) | Prompt: Can you tell me a bit more about that?<br><br>Probe: HOW can it translate into promoting wellbeing? And helping others? (Comparative/evaluative question) | SRQ RO6 |
| | | |

*B.2 Study 2 Longitudinal data collection tools*

**B.2.1 Interview Schedule**

**Research questions**

Over a season,

1. How do female professional ultra-endurance (UE) triathletes perceive, experience and monitor their pain and discomfort levels in training sessions and during competition?

2. How do professional female UE triathletes' control/manage their discomfort or pain? How do they recognise and know the different types of pain?

3. Which, if any, biopsychosocial and emotional factors influence their tolerance levels to pain and controlling/coping mechanisms during training and competition periods? E.g. rest and recovery, mood, emotions

4. What lessons can be learnt from exploring the female UE athlete and their pain management and from specific influencing factors in relation to the mental wellbeing and health of other UE athletes?

**Introductions:**

Rapport with participant – reiterate it will be recorded, and I will make the odd set of notes occasionally. Make sure they feel comfortable; sit at side and use non-verbal communication to engage with them and show I am listening/responding to answers: nodding, eye contact, looking interested, smile.

Sample Interview Guide for Interview 1 in June 2019. The interview questions for February 2020 and October 2020 will be designed based on the journal entries and inventories leading up to the interview, and to discuss progress on their plans.

| Questions: | | Prompts | |
|---|---|---|---|
| General | | | |
| What are your plans and goals for the season? | | Short, medium long-term goals? <br> Races; qualifiers; specific performance measures? <br> What's your definition of success? How do you personally measure it? | |
| **Tolerance and coping related questions** | | | |
| How would you describe your pain tolerance levels for pain or discomfort right now? | | Any recent experiences to recall for pain? <br> What's the difference between discomfort and pain? <br> Can you give examples? | |
| What was the last experience of pain in your training or racing? | | Are you able to expand on that? <br> What were the reflections relating to self-regulation? and how any pain strategies or coping mechanisms were used? | |
| **Pain-interference effects questions** | | | |
| How much has pain or discomfort interfered with your mindset during racing or training recently? | | Are you able to give more details of how you were trying to control the interference please? | |
| **Exploring which factors affect tolerance questions** | | | |
| What do you feel are factors that affect the way you perceive and tolerate pain at the moment? | | To what extent do you believe that your emotions have an impact on how you perceive and experience pain at the minute? <br> Details or examples if comfortable to share? <br> Equally, is pain or discomfort affecting your emotions out of training or competition? | |

B2.2 **Reflective Journal**

Each online journal page will have a series of drop-down boxes for either free text

writing or selecting a number to rate a specific response to the pain-related question. It will

be an online template.

| DATE: | TIME: |
|---|---|

The aim of this reflective journal is to record any weekly learning experiences, plus any pain experiences and perceptions, and how you managed then during training and competition.
Section A will consist of drop-down boxes to select the relevant response
Section B will be more free text type questions for you to reflect on.

**Section A: Training/Competition Monitoring**

1.  Training log- please select the relevant drop-down response for the following:

- Mesocycle phase of training (off/pre/in-season)
- Training Period/Season (build/base/maintenance/speed/taper/overcompensation/supercompensation)
- Duration (miles or km)
- Distance (mins/hrs)
- Intensity (high 95–100%/sub-max 85–95%/low 60–85%)
- Type: Bike/Run/Swim – based on specific types of training, e.g. easy, hills, continuous, techniques, course or similar conditions
- TSS (Training Stress Score) if known
- Race – low or high priority
- Training rating (NRS 1–4; e.g. 1 = felt good during entire workout; 2 = neither hard nor easy, felt good during some parts of training; 3 = somewhat difficult, felt a little tired; 4 = very difficult, had difficulty completing the workout).
- Muscle stiffness (NRS 1–4, e.g. 1 = no pain or stiffness; 2 = mild stiffness and pain, not affecting training; 3 = moderate stiffness and pain, able to complete training; 4 = severe pain and stiffness, unable to complete training).
- Sleep quality (NRS 1–4, e.g. 1 = uninterrupted sleep, feeling refreshed; 2 = interrupted sleep, not requiring more sleep; 3 = interrupted sleep, requiring more sleep; 4 = interrupted sleep, feeling terrible).
- Psychological status (NRS 1–4, e.g. 1 = no depression, good mood; 2 = mild depression, down or sad only at times; 3 = moderate depression, feeling down or sad most times; 4 = severe depression, feeling down and sad all the time).
- Appetite (NRS 1–4, e.g. 1 = very good; 2 = good; 3 = fair; 4 = poor).

**2. My ability to tolerate discomfort or pain during training this week**

0          1          2          3          4          5          6

Completely                                        Not at all

**3. Level of pain/discomfort-related interference affecting my performance this week**

0        1        2        3        4        5        6

Not at all                                              All consuming

**4. My emotions influenced how I perceived and controlled any pain experience this week**

0        1        2        3        4        5        6

Completely                                              Not at all

**Section B – free text answers on learning and experiences**

1. Outline any key learning experiences you had during last week's training and/or competition.
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………

2. Did you experience any pain or discomfort during last week's training and/or competition? If so, please provide details.
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………

3. Recalling a situation this week, how did you manage your pain and discomfort levels?
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………

4. Thinking back to your ability to tolerate pain or discomfort this week, what do you feel influenced it?
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………

### B2.3 RESTQ-Sport Inventory

The RESTQ identifies the current recovery-stress states and provides a complete picture of the actual extent of stress and recovery. The questionnaire is based on the hypothesis that an accumulation of stress in different areas of life, with insufficient opportunity for recovery, leads to a critical psychophysiological state. The RESTQ was developed to measure the frequency of current stress symptoms along with the frequency of recovery-associated activities. Through the simultaneous assessment of stress and recovery, a differentiated picture of the current recovery-stress state can be provided.

A general version (RESTQ-Basic) with seven stress scales and five recovery scales is the foundation for the specific version for athletes (RESTQ-Sport) which is the one I will use as it contains scales measuring specific aspects of stress and recovery in their field. It has a specific time frame of three or seven days/nights. A Likert-type scale is used with values ranging from 0 (never) to 6 (always) indicating how often the respondent participated in various activities or experienced relevant states. The profile of the RESTQ scales will provide valuable information immediately on areas where improvement is needed. The questionnaire is useful for research on stress and recovery and ideal for applied settings.

## RESTQ-Sport Questions and Scales

| | |
|---|---|
| 1 | I felt down |
| 1 | I was fed up with everything |
| 1 | I felt depressed |
| 2 | I was angry with someone |
| 2 | Other people got on my nerves |
| 2 | I was annoyed by others |
| 3 | I was tired from work |
| 3 | I was overtired |
| 3 | I was dead tired after work |
| 4 | I had a good time with my friends |
| 4 | I visited some close friends |
| 4 | I laughed |
| 5 | I felt happy |
| 5 | I was in good spirits |
| 5 | I was in a good mood |
| 6 | I slept restlessly |
| 6 | I fell asleep satisfied and relaxed |
| 6 | I had a satisfying sleep |
| 7 | The breaks were not at the right times |
| 7 | Too much was demanded of me during breaks |
| 7 | I had the impression there were too few breaks |
| 8 | I felt that I wanted to quit my sport |
| 8 | I felt burned out by my sport |
| 8 | I felt frustrated by my sport |
| 9 | I had muscle pain after performance |
| 9 | Parts of my body were aching |
| 9 | My muscles felt stiff or tense during performance |
| 10 | I was in a good condition physically |
| 10 | My body felt strong |
| 10 | I recovered well physically |
| 11 | I dealt very effectively with my teammates'/others' problems |
| 11 | I easily understood how my teammates/others felt about things |
| 11 | I dealt with emotional problems in my sport very calmly |
| 12 | I was convinced that I had trained well |
| 12 | I was convinced that I performed well |
| 12 | I was convinced that I could achieve my performance at any time |

| | | | |
|---|---|---|---|
| 1 | GENERAL STRESS | Overall Stress | |
| 2 | SOCIAL STRESS | | |
| 3 | FATIGUE | | |
| 4 | SOCIAL RECOVERY | Overall Recovery | |
| 5 | GENERAL WELLBEING | | |
| 6 | SLEEP QUALITY | | |
| 7 | DISTURBED BREAKS | Sport Specific Stress | |
| 8 | EMOTIONAL EXHAUSTION | | |
| 9 | INJURY | | |
| 10 | BEING IN SHAPE | Sport Specific Recovery | |
| 11 | PERSONAL ACCOMPLISHMENT | | |
| 12 | SELF-EFFICACY | | |

**B2.4 The Brunel Mood Scale (BRUMS)**

Below is a list of words that describe feelings. Please read each one carefully. Then cross the box that best describes HOW YOU FEEL RIGHT NOW. Make sure you answer every question.

1. Panicky ............................................................ ❏ ❏ ❏ ❏ ❏
2. Lively................................................................. ❏ ❏ ❏ ❏ ❏
3. Confused............................................................ ❏ ❏ ❏ ❏ ❏
4. Worn out............................................................ ❏ ❏ ❏ ❏ ❏
5. Depressed .......................................................... ❏ ❏ ❏ ❏ ❏
6. Downhearted ..................................................... ❏ ❏ ❏ ❏ ❏
7. Annoyed ............................................................ ❏ ❏ ❏ ❏ ❏
8. Exhausted .......................................................... ❏ ❏ ❏ ❏ ❏
9. Mixed-up ........................................................... ❏ ❏ ❏ ❏ ❏
10. Sleepy .............................................................. ❏ ❏ ❏ ❏ ❏
11. Bitter................................................................. ❏ ❏ ❏ ❏ ❏
12. Unhappy ........................................................... ❏ ❏ ❏ ❏ ❏
13. Anxious ............................................................ ❏ ❏ ❏ ❏ ❏
14. Worried............................................................. ❏ ❏ ❏ ❏ ❏
15. Energetic........................................................... ❏ ❏ ❏ ❏ ❏
16. Miserable .......................................................... ❏ ❏ ❏ ❏ ❏
17. Muddled............................................................ ❏ ❏ ❏ ❏ ❏
18. Nervous ............................................................ ❏ ❏ ❏ ❏ ❏
19 Angry................................................................. ❏ ❏ ❏ ❏ ❏
20. Active ............................................................... ❏ ❏ ❏ ❏ ❏
21. Tired ................................................................. ❏ ❏ ❏ ❏ ❏
22. Bad tempered.................................................... ❏ ❏ ❏ ❏ ❏
23. Alert.................................................................. ❏ ❏ ❏ ❏ ❏
24. Uncertain .......................................................... ❏ ❏ ❏ ❏ ❏

For official use only:
Ang: _____ Con: _____ Dep: _____ Fat: _____ Ten: _____ Vig: _____

BRUMS Scoring

Respondents indicate whether they have experienced such feelings on a 5-point scale (0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit, 4 = extremely).

The 24 items comprise the following six subscales: anger, confusion, depression, fatigue, tension and vigour. Each subscale contains four items. When responses from the four items in each subscale are summed, a subscale score in the range 0-16 is obtained. The items in each subscale are:

Anger: annoyed, bitter, angry, bad tempered (items 7, 11, 19, 22)

Confusion: confused, mixed up, muddled, uncertain (items 3, 9, 17, 24)

Depression: depressed, downhearted, unhappy, miserable (items 5, 6, 12,16)

Fatigue: worn out, exhausted, sleepy, tired (items 4, 8, 10, 21)

Tension: panicky, anxious, worried, nervous (items 1, 13, 14, 18)

Vigour: lively, energetic, active, alert (items 2, 15, 20, 23)

### B2.5 The McGill Pain Questionnaire Short Form (SF-MPQ 2)

A multidimensional measure of pain quality. In the short form there are 15 representative words for the athlete to choose: 11 sensory and 4 affective, ranked 0 ('none') to 3 ('severe') for the intensity scale. There is also a Present Pain Intensity (PPI) a VAS, and a body map for locating the pain.

**PPI – select the word that best describes your current pain**

0 no pain

1 mild

2 discomforting

3 distressing

4 excruciating

This guide would help the athletes think about their current pain experiences and reflecting on the nature and intensity of it. It takes approximately 5 minutes to complete. The athlete would complete the body map and scales to illustrate how, where and intensity of any pain or discomfort experienced on any given day. This would be elaborated on in conjunction with the reflective journal entries.

Short form of MPQ with body map

**Short form McGill pain questionnaire and pain diagram**

*(Reproduced with permission of author © Dr. Ron Melzack, for publication and distribution)*

Date: _____

Name: _____

Check the column to indicate the level of your pain for each word, or leave blank if it does not apply to you.

| | Mild | Moderate | Severe |
|---|---|---|---|
| 1. Throbbing | ____ | ____ | ____ |
| 2. Shooting | ____ | ____ | ____ |
| 3. Stabbing | ____ | ____ | ____ |
| 4. Sharp | ____ | ____ | ____ |
| 5. Cramping | ____ | ____ | ____ |
| 6. Gnawing | ____ | ____ | ____ |
| 7. Hot-burning | ____ | ____ | ____ |
| 8. Aching | ____ | ____ | ____ |
| 9. Heavy | ____ | ____ | ____ |
| 10. Tender | ____ | ____ | ____ |
| 11. Splitting | ____ | ____ | ____ |
| 12. Tiring-Exhausting | ____ | ____ | ____ |
| 13. Sickening | ____ | ____ | ____ |
| 14. Fearful | ____ | ____ | ____ |
| 15. Cruel-Punishing | ____ | ____ | ____ |
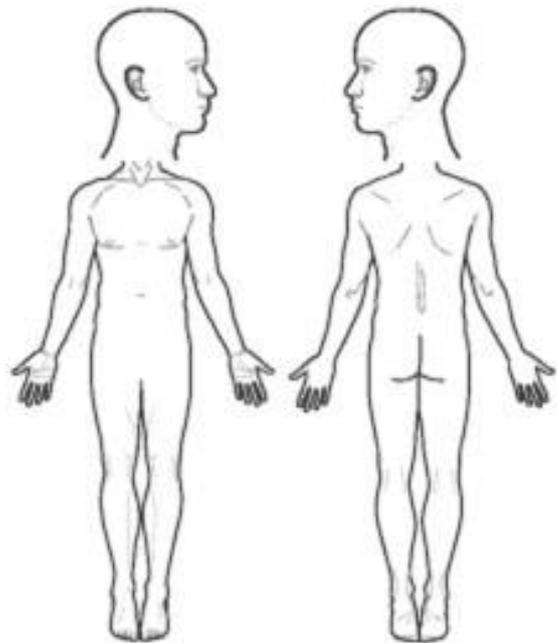
Mark or comment on the above figure where your have your pain or problems

Indicate on this line how bad your pain is — at the left end of line means no pain at all, at right end means worst pain possible

No pain _____ Worst possible pain

| S | /33 | A | /12 | VAS | /10 |
|---|---|---|---|---|---|

## SHORT-FORM McGILL PAIN QUESTIONNAIRE
### RONALD MELZACK

**PATIENT'S NAME:** _____        **DATE:** _____

| | NONE | MILD | MODERATE | SEVERE |
|---|---|---|---|---|
| **THROBBING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **SHOOTING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **STABBING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **SHARP** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **CRAMPING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **GNAWING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **HOT-BURNING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **ACHING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **HEAVY** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **TENDER** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **SPLITTING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **TIRING-EXHAUSTING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **SICKENING** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **FEARFUL** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |
| **PUNISHING-CRUEL** | 0) _____ | 1) _____ | 2) _____ | 3) _____ |

PPI

NO PAIN |————————————————————————————| WORST POSSIBLE PAIN

0  NO PAIN          _____
1  MILD             _____
2  DISCOMFORTING    _____
3  DISTRESSING      _____
4  HORRIBLE         _____
5  EXCRUCIATING     _____
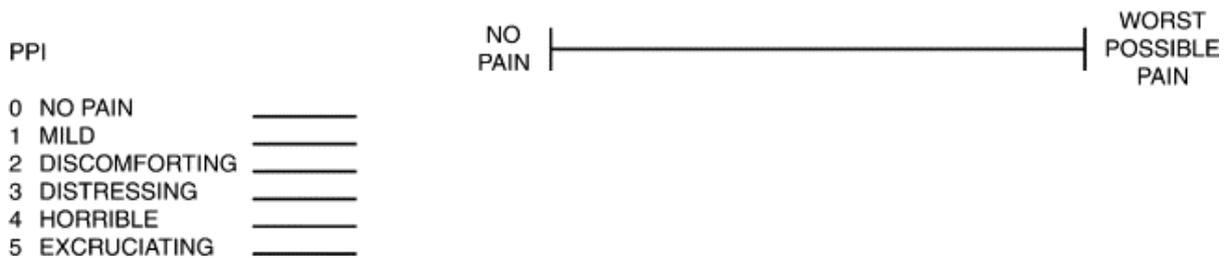
**B2.6 The Sport Inventory for Pain**

The SIP will be used every three months for identifying and predicting the athlete's capacity to cope with pain throughout the season, adapted for three types of ultra-endurance pain:

- race-induced muscular pain
- exertional pain
- injury-related pain

Below is a list of statements that describe the way athletes often feel about discomfort and its influence on performance. Please read each statement and fill in one circle to the right of each statement that best describes your feelings at this time. There are no right or wrong answers. Strongly Disagree Neutral Agree Strongly Disagree Agree

1. I see pain as a challenge, and I don't let it bother me. • • • • •

2. I owe it to myself and those around me to perform even

when my pain is bad. • • • • •

3. When in pain, I tell myself it doesn't hurt. • • • • •

4. When injured, I pray for the pain to stop. • • • • •

5. If I feel pain during a game, it's probably a sign that I'm

doing damage to my body. • • • • •

6. I have little or no trouble with my muscles twitching. • • • • •

7. At this point, I am more interested in returning to my

sport than in trying to stop any pain. • • • • •

8. When in pain, I imagine that the pain is outside my body. • • • • •

9. When injured, I feel that it's never going to get better. • • • • •

10. When injured, I could perform as well as ever if my pain

would go away. • • • • •

11. I do not worry about being injured. • • • • •

12. Pain is just a part of the game. • • • • •

13. When hurt, I play mental games with myself to keep my

mind off the pain. • • • • •

14. When hurt, I worry all the time about whether it will end. • • • • •

15. When in pain, I have to be careful not to make it worse. • • • • •

16. I seldom or never have dizzy spells or headaches. • • • • •

17. When I am hurt, I just go on as if nothing happened. • • • • •

18. When in pain, I mentally replay great past performances. • • • • •

19. If in pain, I often feel I can't stand it anymore. • • • • •

20. The worse thing that could happen to me is to injure/

reinjure myself. • • • • •

21. I seldom notice minor injuries. • • • • •

22. When injured, I tell myself to be tough and carry on. • • • • •

23. When hurt, I do anything to get my mind off the pain. • • • • •

24. When hurt, I tell myself I can't let the pain stand in the way • • • • •

of what I want to do.

25. No matter how bad any pain gets, I know I can handle it. • • • • •

prosecution under the copyright laws. In exchange for using the SIP in your research without charge, you agree to abide by these conditions.

## Description of Subscales

The SIP is a 25-item sport-specific instrument which measures five subscales relevant to competition: direct coping (COP), cognitive (COG), catastrophising (CAT), avoidance (AVD), and body awareness (BOD) (Meyers et al.,, 1992). There is also a total coping response score (TCR = COP + COG - CAT), which serves as an overall indicator of the ability to perform athletically while experiencing physical injury and pain.

The first four subscales, e.g., direct coping, cognitive, catastrophising, and avoidance, represent different types of coping strategies. Direct coping and cognitive subscales were developed to reflect the positive dimensions of an athlete's total pain coping style.

**DIRECT COPING -** The direct coping subscale seems to measure how much immediate attention an athlete gives to pain, discomfort, and injury during competition. High scorers tend to ignore pain, realiserealise that pain is part of competition, and in general, tend to "tough it out". A sample item is *"When hurt, I tell myself I can't let the pain stand in the way of what I want to do".*

**COGNITIVE** The cognitive subscale appears to be a measure of whether a person uses *mental* strategies such as imagery in attempting to deal with pain. Individuals scoring high on the direct coping subscale might also score well on the cognitive subscale, reflecting the ability to incorporate an array of mental techniques to maintain a competitive focus on the task at hand. A sample item is *"When in pain, I replay in my mind pleasant performances from my past".*

**CATASTROPHISING -** The catastrophising subscale detects those who tend to despair when injured. They dwell on the pain, feel that it is unbearable, and have essentially "given up". The sample item is *"When in pain, I worry all the time about whether it will end".* A low score would reflect an individual's ability to minimise catastrophic thinking and maintain an optimistic mindset while experiencing discomfort during athletic competition or rehabilitation.

**AVOIDANCE -** The avoidance subscale was designed to be a measure of the extent to which a person employs avoidant strategies to deal with pain. Thus, high scorers were thought to be less competitive when injured. A sample item is "When in pain, I have to be careful not to make it worse". Recent data suggests, however, that exemplary athletes may also score high

on this subscale since, if injured, they tend to reserve activity for more serious competition, i.e., when it counts.

**BODY AWARNESS -** The body awareness subscale was intended to be a measure of whether a person is hyposensitive or hypersensitive to painful stimuli. As such, it was designed to serve as a possible covariant in pain studies with athletic populations. The subscale has emerged as a compelling predictor of pain response and athletic performance in some sport populations. A sample item is "I seldom notice minor injuries".

**TCR -** Initially referred to as HURT by Meyers and colleagues (1992), the composite score has been modified from the original by omitting the AVD subscale. The TCR, or total coping response, is a composite scale derived by subtracting the CATASTROPHISING score from the sum of DIRECT COPING and COGNITIVE (TCR = COP + COG - CAT). Whereas some individuals may consider avoiding pain to be beneficial to an athlete, others may deem avoidance detrimental in order to successfully achieve a competitive level of accomplishment. Hence, it was felt that a total coping response score would more clearly define overall pain coping capabilities during sports competition.

**Scoring Procedure**

The SIP's brief 25-item design, developed according to predefined scale construct techniques (Anastasi, 1989), facilitates both completion and scoring in an applied setting. A 5-point Likert-type format is used ranging from strongly disagree (1) to strongly agree (5). Subscales and their respective items are shown below:

| <u>Subscale</u> | <u>Items</u> |
|---|---|
| Direct Coping (COP): | 1 + 2 + 7 + 12 + 17 + 22 + 24 + 25 |
| Cognitive (COG): | 3 + 8 + 13 + 18 + 23 |
| Catastrophising (CAT): | 4 + 9 + 14 + 19 |
| Avoidance (AVD): | 5 + 10 + 15 + 20 |
| Body Awareness (BOD): | 6 + 11 + 16 + 21 |
| Total Coping Response (TCR): | COP + COG - CAT |

## B2.7 Summary Table of Monitoring Assessment Tools

| Inventory or Assessment Tool | Assessment focus | Why? | When & how often? | Quant or Qual | Availability/ accessibility |
|---|---|---|---|---|---|
| RESTQ-Sport | Rest and recovery Mood | Provides a complete picture of the actual extent of stress and recovery and monitor over season | Weekly. Online. | Quant | Y Able to buy manual and sheets |
| BRUMS | Mood | Monitor mood over the season | Weekly. Online. | Quant | Y |
| Sports Inventory for Pain (SIP-25) | Coping with pain (but after injury and in rehab) | Sport specific and can adapt to fit UE athlete types of pain | Six monthly. Online. | Quant | Y |
| McGill Pain Questionnaire (MPQ) short form | Measures pain quality, sensory, affective motivational-affective, cognitive-evaluative aspects of pain | Multidimensional assessment of pain: uses body location map, adjectives NRS, 10cm VAS, Present Pain Intensity scale | Weekly. Online. (or as and when athlete feels need to) | Quant | Y |
| Pain behaviour self-report measure using a Number Rating Scale (NRS) using contextualised questions. | Affective behaviour, pain-related interference to performance, pain experience/severity, coping. To assess self-efficacy, control, and emotions. | To obtain day-to-day insight of any changes or fluctuations. | Weekly. Online within journal entry page. | Quant | Y I will design these to contextualise to the sport. |
| Interviews Semi-structured | Discussion based around answering and monitoring progress related to research questions. First interview will ascertain their performance goals for season and race objectives. How they define performance and how they will know if they are successful? | To get an idea of the changes, progress, current situation and how the strategies are working for them. Discuss current lifestyle, health, wellbeing, rest and recovery. Any significant events or experiences outside of sport if relevant to affecting or influencing performance. | Three: at start, middle and end of 17-month period. Face to face for 1st and 3rd interview, if possible, otherwise via Skype/Facetime for all. | Qual | Y Interview schedule to be piloted for final question guide. |
| Reflective Journal | A range of personal reflections on experiences (pain-related and non-pain related), feelings, learning taking place, emotions, psychosocial factors | To monitor how the athlete copes and deals with day to day | Weekly. Online template. | Qual | Y These were designed to contextualise to the sport |

*B.3 Study 3 Data collection tools post-pilot test procedures and reflections*

**B3.1 Study 3 pre-event interview schedule post-pilot revisions**

| MAIN QUESTION | PROMPTS/PROBES | |
|---|---|---|
| **General warm up**<br>• How are you feeling going into this event?<br>• How have you prepared for this event?<br>• | | |
| • Are there any niggles or concerns you have right now?<br>• If so, what are they | Probe: can you explain further? E.g., are these new or old? | |
| **General Pain and Tolerance related questions:**<br>• How would you describe pain?<br>• What do you understand by pain intensity?<br>• How would you describe what pain tolerance means to you?<br>• Thinking about the context of feeling pain during your sport and training for this event, how did you make sense of the pain you were experiencing?<br>• How would you generally describe your own pain tolerance?<br>• Has there ever been a previous time where pain stopped you carrying on in an event?<br>• How have any past experiences influenced your ability to tolerate pain?<br><br>• Thinking back on your preparations for this event, what sort of pain do you expect to feel during this event and where? | Follow up probes:<br><br>How is this different to feeling discomfort? What do different pain sensations mean to you personally? How do you interpret their seriousness?<br><br><br><br>How did you feel? Tell me what you were thinking.<br><br><br><br><br>If so, can you tell me more about that on how it interfered with your mindset?<br>How did you feel?<br>What were you thinking?<br><br>FACTOR EXAMPLES: Weather, temperature, altitude, terrain, fatigue, hormonal side effects if relevant, support along the way, nutrition/hydration, technical or mechanical problems – e.g., practiced changing a puncture/tyre, (in)correct clothing or footwear for the terrain/weather and prevent chafing or other minor injuries; taken massage or other medical advice for injury prevention or management | |
| **Coping** | | |

| | Can you give me some specific examples of what worked well or did not work so well? | |
|---|---|---|
| • From these previous experiences of feeling sensations of pain, how have you normally coped with them?<br>• For this event, how do you anticipate coping with any expected or unexpected pain during this event?<br>• How much pain are you prepared to tolerate during this event? Probe: **locations, intensity, type of pain**<br>• What expectations do you have for yourself regarding event? | | |

## B3.2 Interview schedule 48 hours post-event

Questions: Prompts

**General**

How are you feeling post-race?

**Tolerance and coping related questions**

How do you feel the event went?

After listening to the answer, if not already discussed, steer the athlete to discuss this in terms of coping with any pain and discomfort experienced during the event. Ask them to pinpoint certain difficult/easier moments and how they made it seem like that.

How did your preparations prior to the event help during the event?

Would you do anything differently knowing what you know now?

**Exploring which factors affected tolerance questions**

Which factors positively affected you during the event?

e.g., Weather, temperature, altitude, terrain, fatigue, hormonal side effects if relevant, support along the way, nutrition/hydration, technical or mechanical problems – e.g., a puncture/tyre, gears or brakes issue; incorrect clothing or footwear for the terrain/weather; other people, mood, emotions, minor/major injuries

Which factors negatively affected you during the event?

e.g., Weather, temperature, altitude, terrain, fatigue, hormonal side effects if relevant, support along the way, nutrition/hydration, technical or mechanical problems – e.g., practiced

changing a puncture/tyre, correct clothing or footwear for the terrain/weather, other people, mood, emotions, minor or major injuries

**In your sport Inventory** results you said xxx do you think you feel differently about that now or the same? (Dependent on what is picked out)

This requires the researcher to go through the inventory and check the answers to compare what as said during interview and the verbalisations.

Note: Questions will be written at the time between event finishing and before the 2nd interview 3 days later.

During your event, you talked about xxx, can you tell me a bit more about what happened then and how you felt and coped? (Dependent on what is picked out).

This requires the researcher to listen to the recordings and make notes so that they can ask questions to clarify and seek more explanations of events and experiences.

Do you have any feedback on being a participant for this study?

(e.g., more aware of they interpret pain or discomfort during an event)

More aware of reflecting on how they cope? More aware of any internal or factors specific to this event? Learnt anything new from this whole experience?

How did the think-aloud process work for you?

(Good or bad experiences? Helpful or hindrance? E.g., in coping or reflecting or being aware of things?)

Note: Questions will be written at the time between event finishing and before the 2nd interview 3 days later

### B.3.3 Pilot Study Details and Reflections

To prepare for the field data collection using recording devices, pilot tests were conducted for talking into the two recording devices on a road bike, a mountain bike, and while running on trails. The purpose of this was to test which mode (continuous or Vam: voice activated mode) was best for recording and listening back using Audacity software, ready for transcription. It was decided that a continuous mode would be best as, although it would record bouts of silence and windy noise, no words would be lost. Two more watches would be purchased to ensure a more efficient turnaround swap at designated times, i.e. data uploaded immediately to a laptop and recharged ready for the next checkpoint swap. During checkpoints each device would be checked for clarity of verbalisations and if anything needed to be improved for the next think-aloud block. For example, a bandage was wrapped around the device on the wrist to cut down wind noise and interference.

Three pilot Think-aloud training sessions took place to test the planned training protocol and procedure. The review of this resulted in the instructions being typed to make it easier for the researcher to read out during online zoom training, and the tasks being more contextualised to the sport for the word scramble task and more clarification of the grouped words. This was necessary as the recruited participants were in different countries so the logistics of doing face-to-face training were not feasible. This confirmed the training tasks and that the equipment and sharing of the screen online would work for the training. The review confirmed using think-aloud and the recording device a way of collecting real-time audio data during the race to give an insight into participants' pain experiences immediately.

A pilot of a field test event took place to test the equipment and logistics ready for the Everest ultra-event, using two event organisers for the pilot think-aloud and pain check participants. The results of this confirmed that uploading the verbalisation data was key and re-charging the devices was vital as part of the data collection process. The clarity of the words spoken during the pilot challenge confirmed a cover or sleeve would be used to reduce the wind noise on the watch. The logistics of the planned checkpoints for collecting pain experience data were agreed afterwards with the organisers. An example of the pilot data collected at the summit of Col du Soulor (see photo for example Soulor checkpoint and data collected) which highlights the locations, type of pain, and intensity at that moment in time. This confirmed the efficacy of the adapted laminated card for field testing. As a result of this pilot test event, a single double-sided card per participant per checkpoint would be completed by the researcher, showing the words and body maps as a visual prompt for temporal pain

info. In addition, the conversation would be recorded on the device and a Dictaphone (to be included as part of the Think-aloud QUAL data).

A. Pilot Review Pyrenees

## CHECKLISTS

1. Use one card per person for all pain or discomfort type/location/intensity.
2. Use a Dictaphone (with permission) to record conversation at same time as taking pain data at checkpoints so I get full record of it all.
3. I fill in cards if they are too tired.
4. Have exact number of cards laminated ready for each checkpoint and labelled already.
5. The checkpoints worked well that were used BUT for boucle 1 move the point to later on after last climb near Visca; boucle 2 keep same; boucle 3 use the Spandeles col before the Soulor as well; and think about the Hautacam ascent if they are keen to get the climb in metres exact. Other checkpoints would be back at the hotel where they have to sign in each time before each boucle – this depends a lot on how many participants I am using and logistics on the day.
6. Suggestions from them: use a more detailed location map for the muscles.
7. Also check if the participants like to strava segment their ride and if some checkpoints will interfere with this?
8. Noteworthy – 'numbness' was not on the check sheet.

## Think-aloud

1. Two participants wore the recorders.
2. The verbalisations could be heard and did refer to pain or fatigue or legs. I need to make sure I can hear it fully for transcribing and decide on the level and type of content to include in the transcription.
3. One person was worried she may have lost it as it early came off wrist and another was worried about it running out of battery and she had too many other things charging such as safety stuff and gps to think about charging the wrist recorder.
4. Suggestion: put an elastic band on the strap so no way it would come off.
5. I could buy another one or two recorders as a back up to make sure during the event I can swap at a checkpoint to listen to and make notes. That way I control the on/off and saving data too. Plus, I will be at the hotel for the start. I would need to identify which is which so not mixed up.

**Interview review after**

1. Do the interview at least 48 hrs after so not to exhausted.

2. I need to be more specific about factors that could have affected them.

3. I asked about the coping strategies but could be more prepared for listening to the recordings and having done the pre-event interview and SIP inventory. Although I did get some good examples that were consistent with study 1 participants. E.g., breaking it up, mind games, believing in preparation.

4. Suggestion for pre-event interview – ensure done before the briefing as they will have so much to think about and do in preparation. Also, some questions such as what do you normally do get in terms of pain or discomfort riding mountains? What do you expect to feel in terms of pain or discomfort?

5. Concentrate on the meaning of the experience rather than the experience itself (IPA foundations, i.e., trying to understand the relationship between the participant and something in their world i.e., the pain during the event. And how this is articulated by them as a form of meaningfulness. Access this through language, visual representations, formal data collection interview diaries, and interested in ways people communicate what they have experienced. About an event or process, or about an idea. Capturing their relationship and meaning of their pain. We recreate this in the interview not of their experience, linguistic representation important and significant and worth focussing on.  Experience is something that sits neatly in their intra psychic world.

6. Idea in pre-event is to get a sense of what previous pain experiences meant to them and how helped to shape current perceptions of pain and their ability to tolerate different pain sensations. Post-event it will be about different ways they experienced pain and coped and how the language is articulated to explain this new sense of meaning to them

B. New Digital Recorder Pilot Tests/Results

Recording device worn on wrist during a test run



| RUNNING – 15/6/21; 18.15 | A | B |
|---|---|---|
| BITRATE | Lowest 512 | Highest 1536 |
| WAV OR MP3 | WAV | WAV |
| AUTOMATIC VOICE ACTIVATION ON/OFF | OFF | OFF |
| Memory/time | 255mb/1:09mins | 784mb/1:11mins |
| AUDACITY SOFTWARE CLARITY GOOD/BAD | Conversation can be heard but relevance of this at minute is minimal considering I need to record the conversation on a bike currently. Although this shows that maybe in a boat it could work as long as it doesn't get wet. Not sure about this bitrate though. | |
| LISTENING VIA HEADPHONES GOOD/BAD | I can myself talking but then I knew what I was talking about. Hard to hear Tony's conversation. Clarity is ok. Hopefully the audacity software will be better for clearing the running wind sound i.e. wrist moving. | Similar I can hear myself, but it almost sounds clearer in a way and the conversation between Tony, and I can be followed better. I can still hear the wind from moving wrist in option, but the clarity almost sounds better. Need to test the other bitrates now. Plus put through software. |

| RUNNING – | A | B |
|---|---|---|
| BITRATE | 2nd Lowest 768 | 2nd Highest 1024 |
| WAV OR MP3 | WAV | WAV |
| AUTOMATIC VOICE ACTIVATION ON/OFF | On | On |
| Memory/time | | |
| AUDACITY SOFTWARE CLARITY GOOD/BAD | | |
| LISTENING VIA HEADPHONES GOOD/BAD | | |
| | | |
| CYCLING – 16/6/21; 09.00 | A | B |
| BITRATE | Lowest 512 | Highest 1536 |
| WAV OR MP3 | WAV | WAV |
| AUTOMATIC VOICE ACTIVATION ON/OFF | OFF | OFF |
| Memory/time | 639/2:54mins | 1.88gb/2:55mins |
| AUDACITY SOFTWARE CLARITY GOOD/BAD | So, I can hear myself, but I need to be louder if going along and wind is against me. It makes me think that the best is going uphill as that's when you'd be talking along anyway. It picks up conversation when there's no wind. | I used u-tube videos to learn how to get a better sound quality. Using the noise reduction many times (about 3-4x) plus using the amplification effect and testing/reviewing which was best this can improve sound quality for transcription at last, I hope!<br>1. I need to ensure that they speak clearly into the watch up hills to fully capture anything relating to pain experiences.<br>2. Look at a thin foam or neoprene windsock over the watch to try to reduce wind noise. |
| LISTENING VIA HEADPHONES GOOD/BAD | Clarity quite good but that was at start before riding. Could hear background noise.<br>Very windy and clarity is poor when moving normally. Almost deafening! Hoping it's better with the audacity. | |

C. *Example Adapted McGill Pain Data Sheet for Pilot Checkpoint at Col Du Soulor*



E. The Pilot Pain Checkpoint for Col Du Soulor

D. Study 3 Final Pain Check Form Laminated for Outdoor Use During Ultra-Event

(Post-Pilot Reflection)

(FRONT)

PAIN No.

a.      Where is it? (mark x)
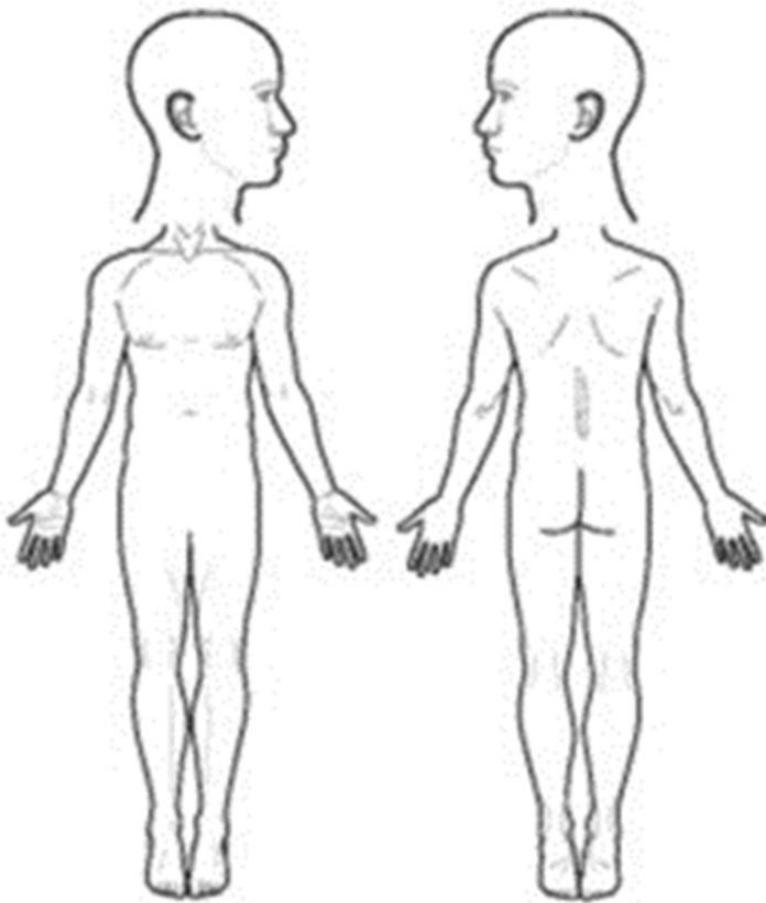


Front                              Back

b.      How bad is it (mark x)?

No pain                                                          Worst Pain

c. What sort of pain is it?

(BACK)

Circle one or more words and amount for each

| Throbbing | Shooting | Stabbing |
|---|---|---|
| Mild/ moderate/ severe | Mild/ moderate/ severe | Mild/ moderate/ severe |

| Sharp | Cramping | Gnawing |
|---|---|---|
| Mild/ moderate/ severe | Mild/ moderate/ severe | Mild/ moderate/ severe |

| Hot-burning | Aching | Heavy |
|---|---|---|
| Mild/ moderate/ severe | Mild/ moderate/ severe | Mild/ moderate/ severe |

| Tender | Splitting | Tiring-Exhausting |
|---|---|---|
| Mild/ moderate/ severe | Mild/ moderate/ severe | Mild/ moderate/ severe |

| Sickening | Fearful | Cruel-punishing |
|---|---|---|
| Mild/ moderate/ severe | Mild/ moderate/ severe | Mild/ moderate/ severe |

E. Adapted Speaking Out Loud Warm Up Tasks

MULTIPLICATION TASK – out loud calculate the sum of these multiplication tasks:
a) 19 x 6 = 114
b) 333 x 11 = 3663
c) 12 x 9 = 108
d) 23 x 4 = 92

ANAGRAM PROBLEM – unscramble these words to say out loud what each one really says:
a) REBZA - zebra
b) LEBCCYI bicycle
c) IPNA pain
d) TERVESE Everest

NAMING PROBLEM – what is the collective name for these words:
a) Alsatian, spaniel, labrador, poodle
b) Tennis, squash, table-tennis
c) Oak, ash, maple, cherry
d) Broccoli, cauliflower, potatoes, beans

'PLEASE THINK-ALOUD ANYTHING THAT COMES INTO YOUR HEAD, DO NOT TRY TO EXPLAIN THESE THOUGHTS'
ON THE BIKE, 'please think-aloud by trying to say out loud anything that comes into your head throughout the practice/bike ride. you do not need to explain your thoughts and you should speak as often as you feel comfortable'.

**Appendix C: Study 2 Supplementary results tables and figures**

*C.1 Study 2* **Abbie's Joint Display Table for QUANT Inventory Data According to Significant Event Weeks.**

| WEEKLY SIGNIFICANT EVENTS CONTEXT | | ABBIE | | | | | 3-Monthly SIP Total Coping Response (TCR) |
|---|---|---|---|---|---|---|---|
| | | Weekly | | | | | |
| | | BRUMS Mood profile and Total Mood Disturbance (TMD) | | RESTQ-36 Sport Rest & Recovery | McGILL Inventory Pain experiences McGILL NRS PPI Ratings: 0-none; 10=worst possible Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe | | |
| | | PROFILE | TMD | Total Recovery (TR) Total Stress (TS) | QUAL pain details | Sum of intensity/NRS | T-scores |
| 2 | 1st IM Race post-injury (Low priority) | Inverse iceberg | 21 | TR 10.33; TS 10.67 | Quads mainly slight ache lower back slight ache shoulders | 5; 3 | 52 |
| 5 | IM race UK (High priority) | Inverse iceberg | 9 | TR 14.33; TS 7.33 | no pain but ache and discomfort - quads, calves, toes/toenails | 7; 0 | |
| 7 | Mood affects tolerance | Submerged | -2 | TR 13.67; TS 8 | Right collar bone / shoulder | 2; 0 | |
| 9 | IM race (High priority) | Inverse iceberg | 10 | TR 11.33; TS 8.33 | Tight shoulders - probably from travel Aching middle of the back. either side of spine | 2; 0 | |
| 13 | IM Race (Low priority) | Submerged | -2 | TR 14.33; TS 7.67 | No real pain | 2; 0 | |
| 15 | Relocation for winter training/lots of swimming | Inverted iceberg | 13 | TR 10.67; TS8.67 | No real pain or discomfort. Some slight aching in shoulders, right collar bone when running on Sunday. Some lower back ache every now and again | 1; 0 | 52 |

| 17 | New Coach | Mild inverted iceberg | 7 | TR 11.67 TS 7 | n/a | 1; 0 | |
|---|---|---|---|---|---|---|---|
| 18 | Race (Medium priority) | Submerged | 4 | TR 12 TS 8 | Some wrist pain / discomfort | 0; 4 | |
| 19 | 2nd Surgery (Spain) to remove plate in shoulder | Submerged | 0 | TR 13.33 TS5.67 | Shoulder (right) surgery on Wednesday 18th to remove the plate in my shoulder, so shoulder area aching / tender / sore | 7; 2 | |
| 25 | Training camp /locked shoulder | Submerged /mild inverted iceberg week prior | 10 | TR 13 TS 5 | Right shoulder - woke up Sunday morning on my shoulder and it was locked up - with limited movement, and very sore and aching. Predominantly on the front of the shoulder / clavicle -no pain from training or during training. Just on waking on Sunday morning and been painful since | 9; 4 | |
| 26 | Diagnosed stress fracture over old injury site | Submerged | 2 | TR 9.67 TS 9.33 | clavicle / shoulder area - achy down the arm - tight muscles along chest / and under arm | 14; 4 | |
| 29 | | | 2 | TR 11.67 TS 7 | Right Collar bone and down my right arm... aching, soreness of the shoulder and surrounding muscles | 6; 3 | 51 |
| 30 | Finds out bone not healing, misaligned and needs re-plating | Inverted iceberg | 15 | TR 9.67 TS 7.33 | Right collar bone and surrounding muscles | 6; 0 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 31 | 3rd surgery to re-plate the same shoulder for a second time | Submerged into mild inverted iceberg | 1 | TR 12.67; TS 5 | Collar bone break right clavicle. It's not pain, just aching, discomfort more than anything and clicking and movement of the bone | 1; 0 | |
| 33 | Travel to UK to be with family during Covid lockdown | Submerged | 0 | TR 11.33; TS 5 | The scar / collar bone is pretty good. No real pain, discomfort anymore. Just getting some pinching of the skin / under skin near my sternum which pulls/ yanks every now and again. | 0; 0 | |
| 37 | Virtual community in bike event | Submerged | 5 | TR 10.33; TS 5.67 | a little aching - right collar bone as rehab and recovery continues - 6 weeks post-surgery | 0; 0 | |
| 40 | Navigating UK health service for X-rays during Covid lockdown | Submerged into mild inverse iceberg | 9 | TR 9.33; TS 6.67 | Right collar bone - mild aching | 1; 1 | |
| 43 | Hit wall and frustration with life | Submerged | 5 | TR 10; TS 4 | mild / slight aching in collar bone at times | 1; 0 | 47 |
| 50 | Virtual bike race (high priority) | Submerged | 2 | TR 11; TS 7.33 | Usual collar bone aching | 1; 0* | |
| 53 | Time trial event | Submerged | 2 | TR 10; TS 7.33 | Collar bone | 1; 0* | |
| 55 | | | | TR 11; TS 6.33 | Collar bone | | 45 |
| 57 | Finally started swimming again | Mild inverted iceberg | 10 | TR 9; TS 5.33 | Collar bone | 0; 0* | |

| 59 | Race 2.5hrs (low priority) | Submerged | 6 | TR 10.67; TS 6.67 | collar bone aching - as usual | 0; 0* | |
| 64 | Moved to Europe/Spain (16hrs) | Submerged | 5 | TR 10.33; TS 7 | collar bone aching right side | 0; 0* | |

| ABBIE | **Joint Display Table for QUANT Weekly Journal entries.** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Ability to tolerate in race/training** | | **Race/training performance affected by interference of** | | **Mood/emotions influenced perceptions/control of** | | **Sleep quality** |
| | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *0=uninterrupted and refreshed; 1=uninterrupted requiring sleep; 2=interrupted sleep not requiring sleep; 3= interrupted sleep requiring sleep* |
| **WEEK** | **6=not all; 0=completely** | | | | | | |
| 2 | 4 | 4 | 2 | 2 | 2 | 3 | other |
| 5 | 2 | 2 | 6 | 2 | 3 | 3 | 2 |
| 7 | 1 | 1 | 6 | 5 | 5 | 4 | 1 |
| 9 | 2 | 1 | 6 | 6 | 4 | 3 | 3 |
| 13 | 1 | 1 | 6 | 3 | 6 | 3 | 1 |
| 15 | 0 | 0 | 6 | 4 | 6 | 2 | 3 |
| 17 | 0 | 1 | 6 | 4 | 6 | 3 | 1 |
| 18 | 1 | 1 | 4 | 4 | 2 | 2 | 1 |
| 19 | 0 | 0 | 6 | 2 | 6 | 6 | 3 |
| 25 | 6 | 6 | 0 | 0 | 6 | 6 | 3 |
| 26 | 3 | 3 | 1 | 1 | 3 | 3 | 1 |
| 29 | 2 | 2 | 2 | 2 | 5 | 5 | 3 |
| 30 | 2 | 3 | 3 | 3 | 3 | 1 | 3 |
| 31 | 3 | 3 | 4 | 3 | 2 | 2 | 3 |
| 33 | 0 | 0 | 6 | 6 | 0 | 0 | 1 |
| 37 | 0 | 0 | 5 | 5 | 0 | 0 | 3 |

| 40 | 0 | 0 | 6 | 1 | 6 | 6 | 3 |
|----|---|---|---|---|---|---|---|
| 43 | 1 | 4 | 6 | 0 | 6 | 0 | 3 |
| 50 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |
| 53 | 1 | 1 | 3 | 3 | 3 | 3 | 3 |
| 55 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |
| 57 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |
| 59 | 0 | 0 | 6 | 6 | 6 | 6 | 1 |
| 64 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |

*C.2 Study 2 Abbie's McGill Pain (MPQ-SF) Longitudinal Results According to Severity of Intensity and Sensory-Affective Descriptors*
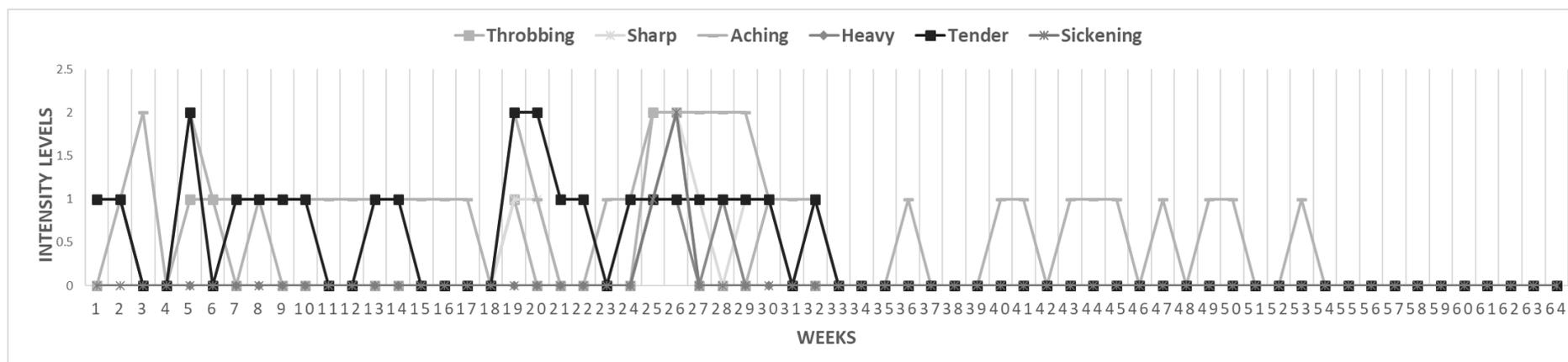


*Note*: Intensity levels: 1=mild; 2= moderate; 3=severe

These pain descriptors were highlighted for their severity across the 64-weeks.

*C.3 Study 2 Abbie's RESTQ-Sport Longitudinal Mean Values According to Overall Scales*
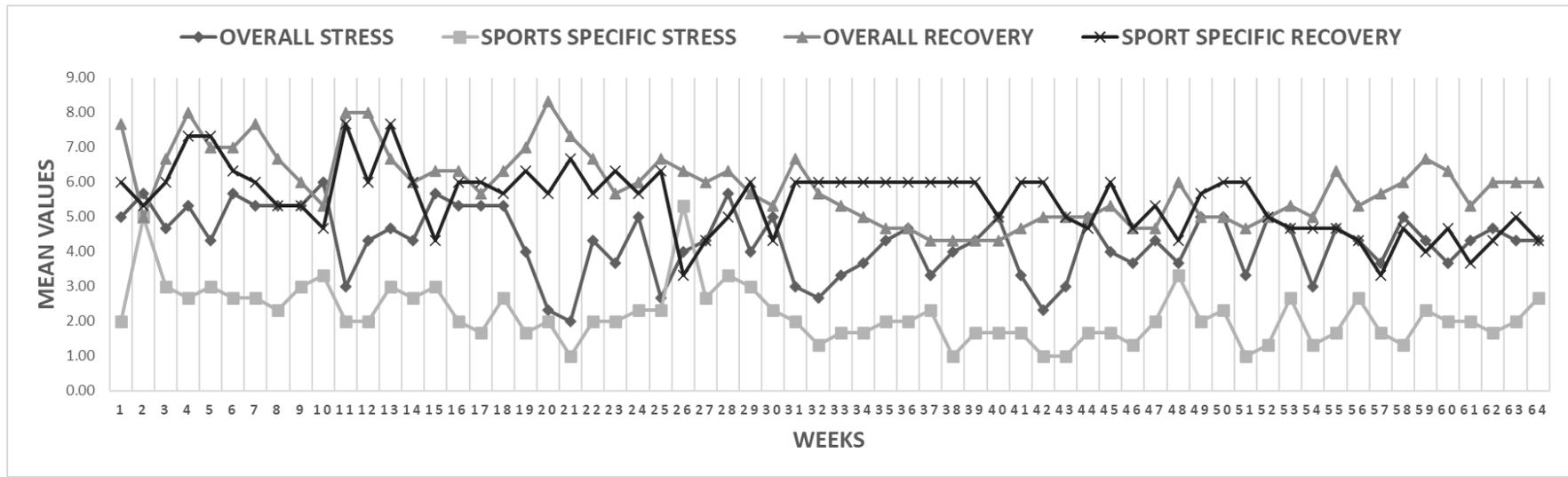
*C.4 Study 2 Tash's Joint Display Table for QUANT Inventory Data, According to Significant Event Weeks*

| WEEKLY SIGNIFICANT EVENTS CONTEXT | | TASH | | | | | 3-Monthly |
|---|---|---|---|---|---|---|---|
| | | Weekly | | | | | SIP Total Coping Response (TCR) |
| | | BRUMS Mood profile and Total Mood Disturbance (TMD) and Vigor T-Score | | RESTQ-36 Sport Rest & Recovery | McGILL Inventory Pain experiences McGILL NRS PPI Ratings: 0-none; 10=worst possible Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe | | |
| | | PROFILE | TMD/ vigor | Total Recovery (TR) Total Stress (TS) | QUAL pain details | Sum of intensity/NRS | T-scores |
| 2 | Mid-season break | Submerged | TMD -5 Vigor 50 | TR 20.67 TS 2.67 | Right glute/buttock | 2; 2 | 47 |
| 5* | Routine disrupted due to travel and two late nights | Submerged mainly/slight surface | TMD -3 Vigor 50 fatigue 53 | TR 18.67 TS 4 | Lower back right hand side. Neural pain and stiffness. Hip left side also locked up - stiff and tight pulling pain | 14; 3 | |
| 6 | Notes effects of inadequate SLEEP | Shark fin | TMD 7 Vigor 36; Fatigue 55 | TR 16 TS 8.67 | Right knee - throbbing. Neck - stuck/sharp pain Lower back - aching | 1; 1 | |
| 8* | Notes worst at spotting when need a break | Surface/ submerged | TMD 9 Vigor 39 | TR 13.67 TS 11 | Right glute/hamstring. Neural pain and muscles pain, stiff and sharp pains. Lower back, aching and stiff Right foot blisters on toes quite bad. Throbbing. Right knee, throbbing and stiff and sore to bend at times. | 1; 3 | |
| 12 | Caught head cold. notes rarely sick and | Submerged | TMD 8 Vigor 36 | TR 16.33 TS 8.67 | SIJ is stiff on both sides, and I have some hip pain right now and ongoing for a couple of weeks. I have been sick again | 8; 2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | realises not as invincible as thought. | | | | this week, so I had a sore head, sinus pain, general tiredness, and achy body at times. I have also had regular stomach cramps. | | |
| 13 | Admits needs to rest more | Iceberg | TMD -9 Vigor 55 | TR 12.33 TS 6 | Slight Achilles ache on left. Usual stiffness in lower back and left hip | 12; 1 | |
| 15* | IM RACE | Iceberg | TMD -10 Vigor 64 | TR 18.67 TS 8.67 | So, this week was Ironman week. And basically, everything hurts during and after a race like this, especially in the heat. I had left Achilles pain pre-race, but it was fine on race day and only slightly stiff after. I have quite severe right knee pain after, and it has lasted a few days and continues. Not unusual. During the race I had the usual neck and shoulder pain on the bike - like being in a stress position for an extended period of time. Then on the run just very heavy legs and painful feet | 20; 3 | 52 |
| 23 | Pre-season | Iceberg | TMD -6 Vigor 55 | TR 20.33 TS 6.67 | Right hamstring insertion. Pain in the tendon, feels like pulling on the bone. Leg feels heavy. Glute dysfunction means leg won't respond as I am used to, and it makes me frustrated. Pain is also in pelvis near the insertion which I find scary and amplifies the pain. Still putting off MRI but have spoken to consultant in UK. Left Wrist - hurt it again doing weights. Not as bad but still annoying as it hurts swimming | 15; 2 | |

| 24 | KNOCKED OFF BIKE 1st MRI Scan | Submerged | TMD 6 Vigor 39 | TR 18.67 TS 5.33 | Left side glute/hamstring/adductor insertion. Not improving. Stopping me running. Painful a lot of the time. Had MRI on Monday (27th) Neck and right shoulder tight and painful. Limited movement. Was knocked off town bike by an out-of-control scooter which gave me sore neck muscles and shoulder all related. Swimming has been difficult | 10; 2 | |
|---|---|---|---|---|---|---|---|
| 27 | Notes pushing overtraining envelope | Iceberg | TMD -1 vigor 58 | TR23.33 TS3.33 | Left glute/hip/hamstring. Pain is definitely getting better - but it is still there. It is a dull ache when not exercising and then a tightness and shooting pain sometimes when exercising. I also damaged a right intercostal this week and that has been truly horrid. Sharp pain with any movement and when I first did it a severe aching | 13; 1 | |
| 29 | Lockdown. Notes 1st time pushing without pain, 'nice' discomfort | Iceberg | TMD -11 Vigor 61 | TR 25.33 TS 3 | Ribs/right intercostals - painful stabbing and aching pain Left glute sometimes dull ache | 6; 1 | 45 |
| 34 | Lockdown | Submerged | TMD -3 Vigor 50 | TR17.67 TS 4.67 | Only slight right glute pains this week and right knee stiffness | 5; 0 | |
| 38 | Complaining tired | Submerged | TMD -7 Vigor 50 | TR 11 TS 6.67 | Right glute pain - neural- and hamstring insertion pain | 5; 1 | |
| 39 | Angry at Covid stopping freedom | Submerged | TMD -1 Vigor 42 | TR 16.67 TS 3.0 | Right lower back. Aching and stiff. Neck stiff. | 6; 3 | |

| 44 | Just having fun | Submerged | TMD 9<br>Vigor 39 | TR 19.33<br>TS 5 | Right hamstring insertion and glute. Really flared up over the last few days. Very painful | 15; 4 | 51 |
|----|----|----|----|----|----|----|----|
| 45 | Injury period. 2nd MRI Scan | Iceberg | TMD -9<br>Vigor 58 | TR 18<br>TS 8.33 | Right lower back and right hamstring. I have finally gotten to the bottom of all the lower back/glute/hamstring pain I have been getting over the years and today I have had a treatment which I hope will mean it will all settle down for good (spinal injection of cortisoids). | 20; 2 | |
| 46 | Notes trying not to let her mental/physical wellbeing be impacted by Covid paranoia in UK | Iceberg | TMD -10<br>Vigor 55<br>Fatigue 40 | | Right glute and hamstring | 14; 0 | |
| 47 | Injury rehab | Low inverse iceberg | TMD 15<br>Vigor 42<br>Fatigue 50 | TR 14.67<br>TS 7.67 | Right glute / hamstring insertion. sharp stabbing pain and into the hamstring. I am sitting in the car writing this, and it is always at its worst when I have been sitting in the car for a while | 15; 6 | |
| 55 | No entry | Submerged | TMD -2<br>Vigor 45 | TR 18.33<br>TS2.33 | Right hamstring/glute/lower back. Right shoulder- stiff and aching. | 10; 2 | 51 |
| 60 | JELLYFISH STING. Trying to return to training after injury. | Submerged | TMD -6<br>Vigor 50 | TR 24.33<br>TS 3 | Right glute and hamstring insertion as per usual. Also had jellyfish sting on Sunday and still have pain (ribs, face, leg) from that | 11; 3 | |
| 62 | Quarantine in UK | Iceberg | TMD -7<br>Vigor 58 | TR 15.67<br>TS 8.67 | Right lower back and glute | 10; 2 | |
| **TASH** | **Joint Display Table for QUANT Weekly Journal entries.** | | | | | | |

| | Ability to tolerate in race/training | | Race/training performance affected by interference of | | Mood/emotions influenced perceptions/control of | | Sleep quality |
|---|---|---|---|---|---|---|---|
| | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *0=uninterrupted and refreshed; 1=uninterrupted requiring sleep; 2=interrupted sleep not requiring sleep; 3= interrupted sleep requiring sleep* |
| **WEEK** | **6=not all; 0=completely** | | | | | | |
| 2 | 6 | 2 | 6 | 6 | 6 | 6 | 1 |
| 5 | 4 | 4 | 1 | 1 | 1 | 1 | |
| 6 | 2 | 2 | 3 | 2 | 1 | 1 | 3 |
| 8 | 4 | 3 | 2 | 2 | 2 | 2 | 3 |
| 12 | 4 | 4 | 3 | 2 | 2 | 2 | 3 |
| 13 | 3 | 3 | 2 | 2 | 1 | 1 | 3 |
| 15* race | 0 | 0 | 6 | 2 | 6 | 0 | 3 |
| 23 | 5 | 5 | 1 | 1 | 2 | 2 | 2 |
| 24 | 4 | 4 | 2 | 2 | 2 | 2 | 0 |
| 27 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| 29 | 1 | 1 | 5 | 5 | 2 | 2 | 2 |
| 34 | 1 | 1 | 5 | 5 | 4 | 4 | 3 |
| 38 | 4 | 4 | 2 | 2 | 1 | 1 | 3 |
| 39 | 4 | 4 | 5 | 4 | 1 | 1 | 3 |
| 44 | 3 | 3 | 1 | 1 | 2 | 2 | 3 |
| 45 | 3 | 4 | 1 | 4 | 1 | 1 | 1 |
| 46 | 5 | 5 | 2 | 2 | 3 | 3 | |
| 47 | 3 | 3 | 2 | 2 | 3 | 3 | 1 |
| 60 | 2 | 2 | 1 | 4 | 1 | 5 | 2 |
| 62 | 4 | 3 | 2 | 4 | 2 | 2 | 2 |

*C.5 Study 2 Tash's McGill Pain (MPQ-SF) Longitudinal Results According to Severity of Intensity and Sensory-Affective Descriptors*
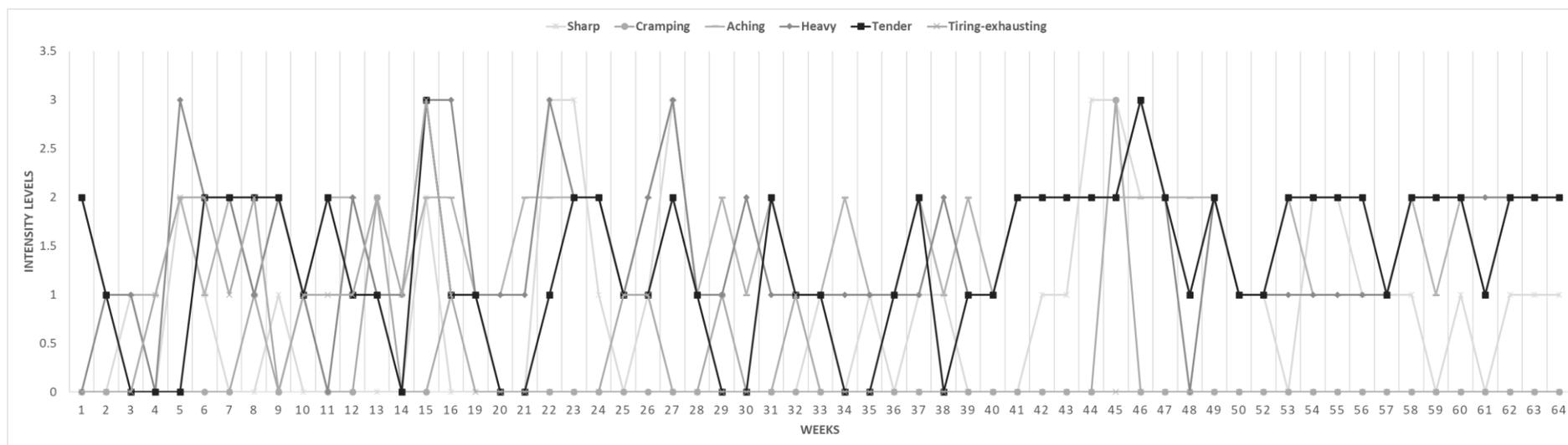


*Note*: Intensity levels: 1=mild; 2= moderate; 3=severe

These pain descriptors were highlighted for their severity across the 64-weeks.

## C.6 Study 2 Tash's RESTQ-Sport Longitudinal Mean Values According to Overall Scales
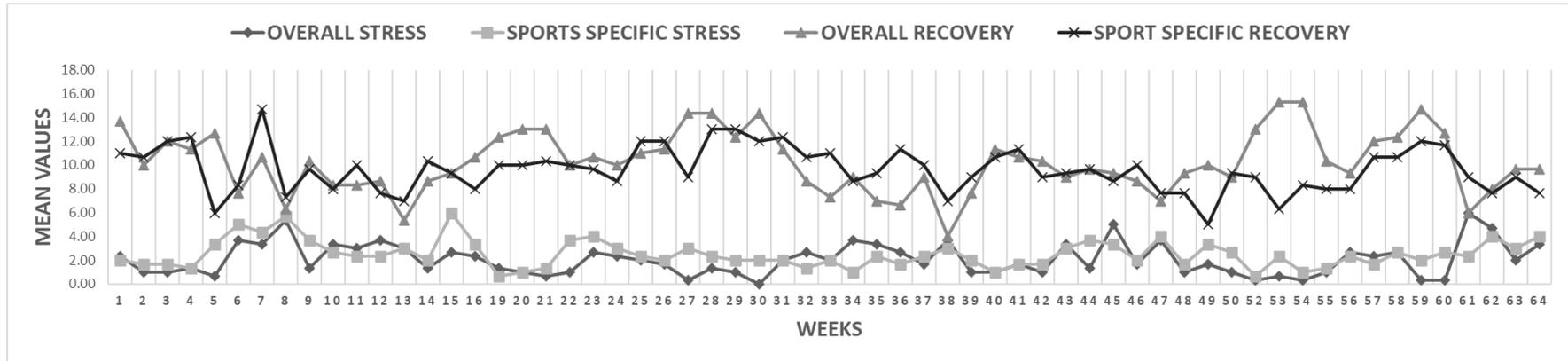
***C.7 Study 2 Eve's Joint Display Table for QUANT Inventory Data, According to Significant Event Weeks***

| WEEK SIGNIFICANT EVENTS CONTEXT | | EVE | | | | | 3-Monthly |
|---|---|---|---|---|---|---|---|
| | | Weekly | | | | | |
| | | **BRUMS Mood profile and Total Mood Disturbance (TMD)** | | **RESTQ-36 Sport Rest & Recovery** | **McGILL Inventory Pain experiences McGILL NRS PPI Ratings: 0-none; 10=worst possible Sum of all intensity ratings chosen for sensory or affective descriptors: 0=none; 1=mild; 2=moderate; 3=severe** | | **SIP Total Coping Response (TCR)** |
| | | **PROFILE** | **TMD/ VIGOR** | **Total Recovery (TR); Total Stress (TS)** | **QUAL pain details** | **Sum of overall intensities /NRS** | **T-scores** |
| 1 | Feeling overtrained and fatigued. | Submerged | TMD 1 Vigor 31 | TR 10.67 TS 16.33 | Quads - heavy / fatigued Left calf - tight Left plantar - tight / sore Right rotator cuff - twinges when swimming occasionally Generally sluggish all-over Left foot - cracks when getting out of bed in the morning lower back - mild ache | 9; 3 | |
| 2 | Training camp | Submerged | TMD -5 Vigor 42 | TR 21 TS 3.33 | Still a tight left plantar- but otherwise - my body feels surprisingly good after a slightly higher load training week | 4; 3 | 68 |
| 3 | IM Race (9th) | Submerged | TMD 2 Vigor 31 | TR 15.67 TS 8 | Still issues with left plantar. right seems good now - had a little ache in the right heel after racing, quads pretty heavy from training load. slightly tight calves from training. lower back a little achy | 7; 2 | |
| 7 | Ongoing foot issues | Shark fin | TMD 6 Vigor 28 | TR 22.33 TS 5.67 | Still having issues with left plantar. and some mild tenderness in left quad outer side just above knee (think related to foot) and | 4; 0 | |

| | | | | | just tightness. Quads generally tender / fatigued | | |
|---|---|---|---|---|---|---|---|
| 8 | IM race low priority (6<sup>th</sup>) | Submerged | TMD -1 Vigor 34 | TS 29 TS 3 | Plantar and left foot pretty sore this morning after racing. Quads heavy after racing. Otherwise - feel pretty good | 4; 2 | |
| 10 | Race DNF | Submerged | TMD 1 Vigor 36 | TR 19 TS 12.33 | I have a pretty sore lower back (this is a dull achy pain) and my left plantar has kicked off the last few days therefore taking a little break from running. This is more immediate discomfort and localised to the underside of the foot | 7; 4 | |
| 11 | Seeks medical advice for foot injury | Submerged | TMD -5 Vigor 50 | TR 25 TS 4 | Still issues with the left foot - which intensified significantly after Thursday run (following a week of no running). Seeing medical professional now Low back achy. Otherwise - fine | 5; 3 | |
| 12 | Change of coach. Stress reaction injury. Had an exhaustion and training meltdown. | Submerged | TMD -7 Vigor 47 | TR 13.33 TS 5.67 | I have now been diagnosed with a stress reaction in my heel and a slightly aggravated plantar. Left foot. Lower back achy | 3; 3 | |
| 15 | Trying to mix it up and find the love again. Taking the pressure off | Inverse iceberg/ submerged | TMD 3 Vigor 39 | TR 14 TS8 | Still issues with left foot Rotator cuffs have been a little sore the last couple of days Legs feel heavy after ride yesterday. Generally ok | 3; 0 | 45 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | while I can't run | | | | | |
| 19 | Starts running again | Submerged | TMD -1 Vigor 31 | TR 20.33 TS 2.67 | Shoulders a little tender from long strength swim this morning. Foot is getting better slowly | 2; 1 | |
| 29 | Trained with friends on long ride | Submerged | TMD -3 Vigor 39 | TR 27 TS 2 | Left quad is a bit tight after running yesterday, otherwise good | 3; 1 | 46 |
| 30 | Feeling flat and low about training. Not happy. | Inverse iceberg | TMD 14 Vigor 31 | TR 17.33 TS 7 | achy legs. Generally tired due to restless sleep | 4; 1 | |
| 31 | Training camp cut short due to covid | Submerged | TMD -3 Vigor 36 | TR 27 TS 2.67 | Just achy legs and fatigued | 6; 1 | |
| 32 | Lockdown starts | Submerged/ surface | TMD 3 Vigor 45 | TR 21 TS 5 | Slight soreness in my left foot again | 3; 1 | |
| 36 | Virtual ride with friends | Submerged | TMD -4 Vigor 39 | TR 23 TS 2 | Just achy quads after sitting for long periods of time | 3;1 | |
| 37 | Zwift ride with others | Submerged | TMD 2 Vigor 28 | TR 23 TS1.67 | n/a | 0; 0 | |
| 42 | Fell off mountain bike | Submerged | TMD -4 Vigor 42 | TR 25.33 TS 1.33 | right hamstring a little tight and right shoulder rotator cuff | 3; 1 | 45 |
| 44 | | Submerged/ low inverse iceberg | TMD 8 Vigor 28 | TR 17.33 TS 4 | | 2; 0 | |
| 48 | Virtual mountain run. Closest | Submerged | TMD 2 Vigor 28 | TR 29.67 TS 0.33 | My quads are pretty fatigued and tender from yesterday's uber run in the mountains. My left calf a little tweaky. My glutes are | 4; 3 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | to a race. Low key | | | | also sore. but all good sore (apart from the calf) | | |
| 49 | Post-mountain run. Benefitted from being away for few days | Submerged/ low iceberg | TMD -8 Vigor 50 | TR 23.33 TS 2.33 | n/a | 1; 0 | |
| 51 | | Submerged | TMD 4 Vigor 28 | TR 28 TS 1.33 | n/a | 0; 0 | |
| 52 | | Submerged /low shark fin | TMD 5 Vigor 28 | TR 23.67 TS 3 | n/a | 0; 0 | |
| 53 | Race low priority | Submerged | TMD -1 Vigor 39 | TR 19.67 TS 5 | n/a | 0; 0 | |
| 55 | Race prep | Submerged | TMD -8 Vigor 50 | TR 26 TS 0.33 | knot in right calf. discomfort not pain | 0;1 | 53 |
| 56 | Race high priority (6th) | Submerged | TMD 1 Vigor 31 | TR 28.33 TS 1.33 | n/a | 2; 0 | |
| 57 | Calf strain. See osteopath. | Low inverse iceberg | TMD 7 Vigor 36 | TR 21 TS 5 | slight calf strain on my right calf. stopped me running yesterday. tight hamstrings sore lower back | 3; 1 | |
| 59 | Needed time out for wellbeing | Submerged | TMD 1 Vigor 28 | TR 14.33 TS 5.33 | n/a | 0; 0 | |
| 61 | Time trial race. Low priority | Submerged | TMD -8 Vigor 50 | TR 29.67 TS 0 | Struggled to get going in first half of TT. Due to discomfort/ being cold. | 0; 0 | |
| 63 | Little bike crash | Submerged / very low iceberg | TMD -8 Vigor 50 | TR 28.67 TS 2 | Little bike crash yesterday. Swollen right knee. A few grazes. Nothing major but a little sore | 2; 0 | |
| EVE | **Joint Display Table for QUANT Weekly Journal entries.** | | | | | | |

| WEEK | Ability to tolerate in race/training | | Race/training performance affected by interference of | | Mood/emotions influenced perceptions/control of | | Sleep quality |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *Pain* | *Discomfort* | *0=uninterrupted and refreshed; 1=uninterrupted requiring sleep; 2=interrupted sleep not requiring sleep; 3= interrupted sleep requiring sleep* |
| | **6=not all; 0=completely** | | | | | | |
| 1 | 4 | 4 | 5 | 2 | 1 | 1 | 1 |
| 2 | 0 | 0 | 6 | 6 | 6 | 6 | 0 |
| 3*race | 2 | 1 | 5 | 2 | 5 | 2 | Generally, a good week's sleep. But the night after the race I didn't sleep well at all and 'woke' feeling very tired |
| 7 | 1 | 1 | 5 | 5 | 5 | 5 | 2 |
| 8*race | 1 | 1 | 5 | 5 | 5 | 5 | 2 |
| 10*race | 4 | 4 | 1 | 1 | 1 | 1 | 3 |
| 11 | 2 | 2 | 1 | 1 | 1 | 1 | 0 |
| 12 | 6 | 6 | 0 | 0 | 0 | 0 | 0 |
| 15 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| 19 | 0 | 1 | 6 | 6 | 6 | 6 | 0 |
| 29 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |
| 30 | 1 | 1 | 6 | 6 | 1 | 1 | 3 |
| 31 | 1 | 1 | 5 | 5 | 3 | 3 | 1 |
| 32 | 6 | 6 | 4 | 1 | 0 | 0 | 0 |
| 36 | 1 | 2 | 6 | 5 | 4 | 2 | 2 |
| 37 | 1 | 3 | 6 | 5 | 4 | 4 | 1 |
| 42 | 1 | 1 | 5 | 5 | 5 | 5 | 2 |
| 44 | 1 | 1 | 5 | 5 | 5 | 5 | 3 |
| 48*race | 0 | 0 | 6 | 6 | 6 | 6 | 1 |

| 49 | 3 | 3 | 1 | 1 | 6 | 6 | 2 |
|---|---|---|---|---|---|---|---|
| 51 | 0 | 0 | 6 | 6 | 6 | 6 | 3 |
| 52 | 0 | 0 | 6 | 6 | 4 | 4 | 1 |
| 53*race | 1 | 1 | 6 | 6 | 5 | 5 | 1 |
| 55 | 1 | 1 | 5 | 5 | 5 | 5 | 3 |
| 56*race | 1 | 1 | 5 | 5 | 3 | 3 | 1 |
| 57 | 1 | 1 | 2 | 2 | 3 | 3 | 1 |
| 58 | 6 | 6 | 6 | 6 | 0 | 0 | 1 |
| 59 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 61 | 0 | 0 | 5 | 5 | 2 | 2 | 1 |
| 63 | 0 | 0 | 6 | 6 | 2 | 2 | 0 |

*C.8 Study 2 Eve's McGill Pain (MPQ-SF) Longitudinal Results According to Severity of Intensity and Sensory-Affective Descriptors*
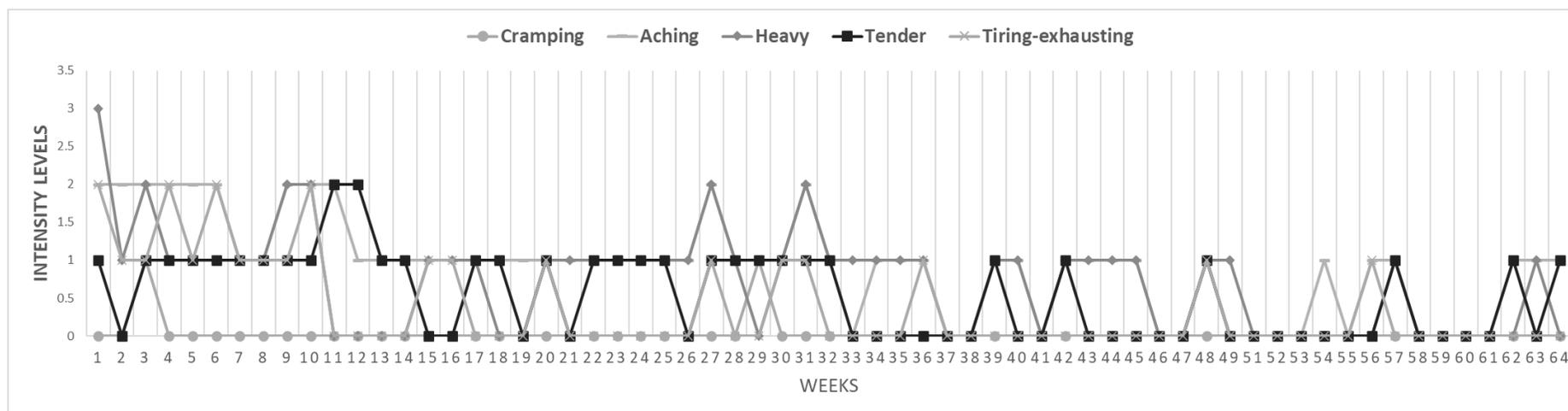


*Note*: Intensity levels: 1=mild; 2= moderate; 3=severe

These pain descriptors were highlighted for their severity across the 64-weeks.

*C. 9 Study 2 Eve's RESTQ-Sport Longitudinal Mean Values According to Overall Scales*
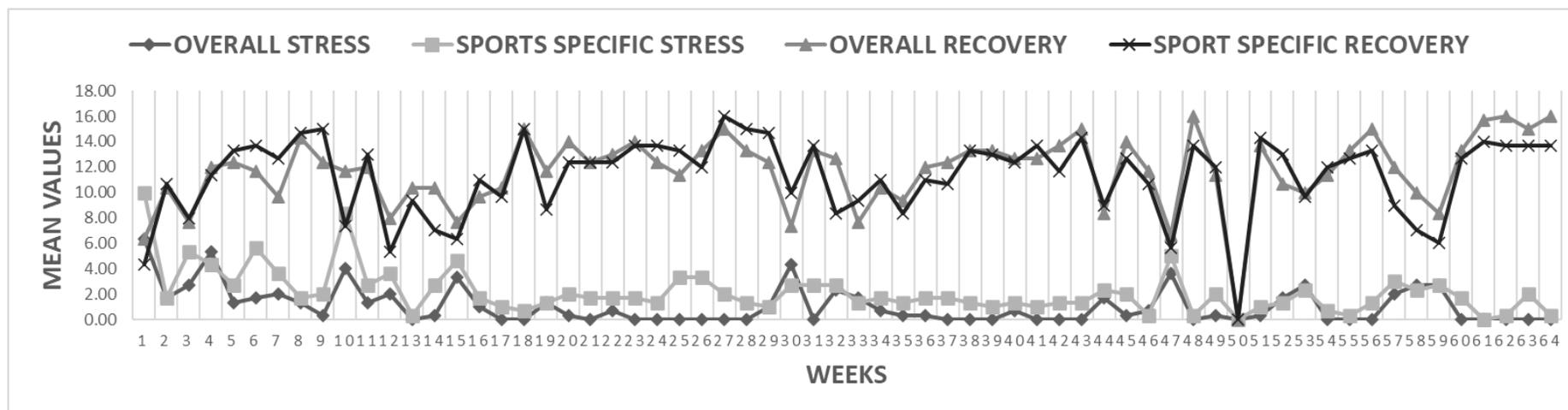
**Appendix D: Study 3 Supplementary Tables**

*D.1 Study 3 Trudy's Joint Display Tables for Pre-, During, Post-Event Data.*

| Trudy -XTri | Pre-event (Forethought) | During event (Performance} Think-aloud | Post-event (Reflective) |
|---|---|---|---|
| | | | |
| **Quant: SIP T-Score** | COP 49; COG 46; CAT 43; AVD 17; BOD 45; TCR 50. | | |
| | | | |
| **QUAL: Coping strategies** | Preparedness/planning for event to manage stomach, foot, effects of cold Internal sensory monitoring, foot | Swearing Internalise pain for foot Self-talk Hand warmers | "I needed to internalise this pain cos I was vocalizing the pain cos it's admitting it's unbearable and it is bearable and get on and internalise it and get on quicker". So, by the end she was drawing upon her usual mantras: "can you move any quicker, is this as fast as you get" |
| **Perception of pain** | Injury-related (foot) Illness related – stomach ulcer Exercise-related – effects of cold for swim training<br><br>High pain tolerance levels | Exercise-related e.g. stomach, neck/shoulders, lower back Effects of cold on feet/hands Injury-related – foot<br><br>"lower back on the right is tight; erm hammy on right is starting to grumble; both expected but not too bad right now. Lady bits [laughs to self] really starting to be sore but not too bad, I've had worse" | |

| Influences +<br>Perception/coping | Past pain experience and testing<br>Interdisciplinary support<br>Cold water training | Support crew<br>Active self-regulation strategies<br>Ignore pain | Preparedness<br>Ignoring pain<br>Support crew<br>Reflecting on how she managed to cope with pain<br>"I think breaking it down is a good mental strategy cos if you think of the whole thing it can be overwhelming". |
|---|---|---|---|
| Influences –<br>Perception/coping | | Cold weather<br>Mountainous terrain<br>"I need a pee. Holy crap. Only done 120. Last 10km took forever." | Recovery from covid<br>Poor sleep<br>Mood<br>Lack of physical training for the time trial position<br>No overshoes<br>"the foot hurt and every time I stood on the uneven ground, and I was swearing so much". |

**D.2 Study 3 Judith's joint display tables for pre-, during, post-event data.**

| Judith – 24h track | Pre (Forethought) | During (Performance} | Post (Reflective) |
|---|---|---|---|
| | | | |
| **Quant: SIP T-Score** | COP 47; COG 46; CAT 54; AVD 54; BOD 31; TCR 45. | | |
| | | | |
| **QUAL: Coping strategies** | Preparedness/planning for event to manage stomach, kit for warmth, preventing blisters, painkillers, nutrition Goal setting: British record | Active self-regulation strategies Active distraction Outward monitoring Internal monitoring Crew support Sports massage self-talk: "Come on legs", "counting it down", and changing the pace: "Walk break. Another one. Lots of walk breaks. Got 4 and a bit left to get to the 220 qualifying distance aargh". | |
| **Perception of pain** | Illness related – cold Previous back fracture High pain tolerance levels | Exercise-related e.g. stomach, "constapoo" neck/shoulders, legs "The sun's gone down, well, it never really came up. Very breathless. No major injuries, just tight hamstrings as usual. But I'm just trying to ignore them, and I did a shoe change at 6 and a half hours" | Wrist hurting from wearing big Garmin watch for so long |
| **Influences + Perception/coping** | Support crew Interdisciplinary support Music | Support crew Support infrastructure on trackside Other runners | Preparedness Ignoring pain Music |

|  |  | Active self-regulation strategies: music, self-talk<br>Ignore pain<br>Change of shoes<br><br>"I've got ginger again cos my guts are a bit funny". | Support crew<br>Sports massage<br>Rest/sleep 45 mins |
|---|---|---|---|
| **Influences –**<br>**Perception/coping** |  | Cold weather<br>Windy<br>Top end of track<br>Feeling unwell: lack of sleep, |  |

### D.3 Study 3 Leah's Joint Display Tables for Pre-, During, Post-Event Data.

| Leah -A100 trail run | Pre (Forethought) | During (Performance} | Post (Reflective) |
|---|---|---|---|
| | | | |
| **Quant: SIP T-Score** | COP 51; COG 33; CAT 54; AVD 42; BOD 45; TCR 43. | Ignores pain "Cataloguing it and leaving it" (leg 3) | |
| **McGill MPQ-SF** | | All exercise-related. Some old injury-related by end. Route 1: a bee sting which had produced a sharp and moderate sensory pain initially but settled. Pain/discomfort starts earlier than expected Route 2: "feeling the effects that I've not trained properly for the last 4 months" as her leg muscles had a tired pain, and her foot tendon was making itself aware to her. However, as she said about her pain tolerance "tender probably only mild. Tiredness is aching, mild. You have to remember that my severe is a broken ankle" when asked about the severity of tendon pain. Route 3: Glutes, Hamstrings and quads are all quite tired tight probably reaching moderate by now maybe. That sort of achy done too much. with occasional sharp pain in hip flexors here. [I ask about physio tape on body part] yeah That's my old injury because I've got a tear in the posterior tibial tendon, so if I put that on then it doesn't.. [I ask if it helps not feeling it] erm it doesn't seem to affect. It's not so | |

| | | much when I'm running its more when I stop running. It used to hurt when I was running .... it's only mean it's only the longer runs the like 20+ runs that I put tape on. I've discovered that yes, I can do a marathon 50k run without the tape but its gonna ache for days afterwards whereas if I put the tape on I don't. [ask about shoulder] Occasionally getting a twinge here or there [points to on chart] but not all the time now and then for a short while then goes away again -sharp moderate when it comes.<br>[I ask if same for hip flexors] says yeah. right now. scale just really tired. the muscles don't want to do any more not injured type of pain.<br>[asked if talking about it made a difference again] not too bad. I'm just cataloguing it and leaving it. It's not the pain so much as if I'm trying to say. other stuff when I was a bit negative. I just wanted to get it over with.<br><br>Route 4 in a word tired. ...glutes tired and out hips hurt tired. Quads and hamstrings also tired. I had a couple of bouts of hip flexors here getting really tight but that was temporary passed off you know, that happened several times. Shoulders were again pack on soreness, same they were getting sore. The other pain hasn't come back in last lap now I've stopped the top of the toes just a little<br>That's mild rest are moderate. I mean the legs nearly all of it is aching its sharp | |
|---|---|---|---|
| **QUAL: Coping strategies** | Preparedness for event.<br>Kit changes<br>Nutrition (vegan) | Active distraction<br>Active self-regulatory strategies<br>Outward monitoring | |

| | | | |
|---|---|---|---|
| | Pro plus<br>Goal setting to finish (maybe sub24h) | Athlete support run/walk/chat<br><br>"Legs are at the stage where I'm struggling to keep the momentum going, can do maybe 50 strides with each leg, and then I need a walking break, so let's try another 50". | |
| **Perception of pain** | High pain tolerance levels | All exercise-related, apart from a bee sting.<br><br>"ok even those few minutes stopped has stiffened my legs up. That's to be expected. Quads are definitely feeling stiff. And glutes. But there we go". (last route) | |
| **Influences + Perception/coping** | | Athlete support<br>Partner support: "feeling a bit low so I thought I'd phone you to cheer me up"<br>Preparedness with kit. Kinesio tape<br><br>Nearly finished: "not sure I want to stop and deal with it. So close to finishing" | Supportive partner/"Running widow".<br>Running with others<br>To block negative thoughts.<br>Walk/run |
| **Influences – Perception/coping** | Grief for her mother's death and lack of training.<br>Rainy weather just before start - mood | Bee sting<br>Lack of training<br>Gut was "not happy"<br>"Nausea. Walking for a bit to settle, to let my stomach settle, I must've drunk, eaten too much" | still feeling disappointed at not achieving her A race goal of going sub-24, and although she knew why, it was still hard and emotional for her to accept.<br>Still grieving for mother. |

### D.4 Study 3 Zoe's Joint Display Tables for Pre-, During, Post-Event Data.

| Zoe – Everest Cycling | Pre (Forethought) | During (Performance} | Post (Reflective) |
|---|---|---|---|
| | | | |
| **Quant: SIP T-Score** | COP 51; COG 33; CAT 39; AVD 26; BOD 41; TCR 47. | | |
| McGill MPQ-SF | | Route 1 "I've got this thing on my knee where I packed my bag too much, it's rubbing. My toes are a bit numb on the left leg but that comes and goes. If that comes and goes its ok". <br><br> Route 2 "I can't even think, I'm in a world of pain…and I have to keep stopping, I have to keep stopping [really out of breath] I nearly didn't come up here I was in such a bad place". The McGill pain data showed a range of locations around the whole body which included the expected hip niggle: "My hip and things are stabbing; it's getting moderate to severe now". <br><br> Route 3 "there's a bum pain from the saddle and there's pain in my feet but the hip is not that bad right now. And I'm just feeling like I normally am" | |
| **QUAL: Coping strategies** | | Day 1 other riders for navigation <br> Day 2 active self-regulation <br> Internal monitoring <br> Outward monitoring | |
| **Perception of pain** | High tolerance for pain | All exercise related <br> Day 1 Magnified by mood and anxieties, guilt | |

|  | | | |
|---|---|---|---|
|  | More discomfort than pain<br>'nurofen scale' for pain and swimming<br>Mental wellbeing | "Left leg feels like a wooden leg right now" , "really should've stretched my hip cos it's really twinging now", and "I've got this thing on my knee where I packed my bag too much, it's rubbing. My toes are a bit numb on the left leg but that comes and goes. If that comes and goes its ok".<br><br>Day 2 same pains but perceived differently as feeling positive<br><br>"…if you come abroad to cycle, you need to have 2 days at least to sort yourself out [heavy breathing] steep, its steep right now... Ah bum". |  |
| **Influences +**<br>**Perception/coping** |  | Day 2 "without the stress of people, and speeds and navigation worries I feel like a different person, so I need to remember that…" |  |
| **Influences –**<br>**Perception/coping** | Sociocultural: 'Mom guilt'<br>Lack of partner/family/friends' support<br>Psych: Anxieties/worries on navigation, hip pain, | Day 1 mood, anxieties, low confidence/self-efficacy<br><br>"Cycling in another country... adds like another layer of tiredness, so it's like...I just don't feel in same…cycling ability as I am in my own, in my own space. It's weird"<br><br>"the only thing that's stopping me from turning back is [laughs as says it] that I don't know the way back home". | Worrying about getting PCR test to go home |

*D.5 Study 3 Nathalie's Joint Display Tables for Pre-, During, Post-Event Data.*

| Nathalie – Everest Cycling | Pre (Forethought) | During (Performance} | Post (Reflective) |
|---|---|---|---|
| | | | |
| **Quant: SIP T-Score** | COP 51; COG 33; CAT 39; AVD 26; BOD 28; TCR 47 | Ignores pain | |
| **McGill MPQ-SF** | | Route 1 It's funny I saw you [at 1st pain checkpoint], you asked me about pain, and I totally forgot about my lower back pain cos it is not the usual one and I refuse to accept it. I know the knee one so I know it is going to go away so I forget about it, the lower back one could be a bit more different or I don't know what it is, it's not usual I decided to ignore it so I totally forgot about it when you asked me looking at the picture on the bodies I forgot about it. I just refuse to accept it; I ignore it there is no lower back pain funny (laughs) I found it again as soon as I started cycling again after I saw you in Viscos

Route 2 "So although there is nothing like sharp pain it's all on my legs basically it's just like ah I got the back (probably looking at diagram) so all that part here and just like all the muscles these two, these two and the left one it's just like my xxx is burning but that's I think it's purely me".

Route 3 "No pain or anything and like I slept well actually I think I slept for more than 7 hours which is a lot… So feeling perfectly fine …usually I feel like my ass or | |

| | | something but like na but fine obviously like it was like OK you feel that but everything is fine" | |
|---|---|---|---|
| **QUAL: Coping strategies** | Won't accept it, ignores pain Previous experience "…if you start accepting or letting a place in your mind for that pain [it] isn't going to help you, it's gonna stop you, your head, you want to finish…you don't have any options so ignore it…that kind of thought is not allowed in my mind! | Active self-regulation Active distraction Music/ipods Outward monitoring scenery counting: "one, two, three, four. One, two, three, four. When I am counting you have to try to keep some rhythm and not to be too slow, so I count pedal strokes…on the limit. Nearly there". | |
| **Perception of pain** | "Pain can be something like very intense when you do more like a competition and the legs are burning your lungs are hurting and it is really super intense and really painful; when you go long distance you never go to that level of effort…because it is not the point that is not | "Going downhill is actually painful cos I am just stretched; I am just like holding the break for a long period of time toward the end unint are quite painful. Your shoulders are very contracted" "Talking about, body check. If I listen to my body right now everything will hurt so my right shoulder is saying yeaaah, my lower back is kind of like 'hello!' my right thigh it is like 'coocoo' and I am just like because it is post lunch, not great moment…not gonna listen to you gonna put some music on. That's all. No more body check right now, not useful." | |

| | | | |
|---|---|---|---|
| | how you manage er long distance so it is not pain you feel; discomfort you notice if something is a bit wrong like my saddle was exchanged" | Feeling good. Got my fingers [back], "my legs are definitely reminding me that they exist but [there is] no specific point. I had a big snack, but the digestions are OK in the morning potentially because it is not too hot. Because it is quite steep my lower back is a problem I'd say. But it's kind of like two out of ten"<br><br>"Right for the purpose of the study I would not normally pay attention to it but got some kind of pain on the side not the lower back pain which would have been like a horizontal bar now a vertical one on the side the beginning it was kind of a stitch in the same way stuff you have on your run it's just there on the side, might disappear. Oh la [sic] it's beautiful I am enjoying it but it's good" | |
| **Influences + Perception/coping** | | Going alone at own pace<br>Partner support for pain concerns<br><br>"great news is like I changed my cassette so going uphill …so I don't need to pedal hard…my heart rate doesn't have to go that high will be easier to manage because it is a bit relaxing or comforting". | "I was anorexic when I was 16 for one year, I was bulimic from er 17 to 22 when I was in the UK in shared accommodations sharing with my friend. Came back in 2018 er I've seen some kind of coaches or psychologists since but it has been there since 2018 erm sport it does help: at the beginning I got into long distance cycling because of that…was clearly a way to compensate and now became a habit and makes me feel better;" |
| **Influences – Perception/coping** | | Social: waiting for others at their pace<br>Pressure of having others riding behind<br>Env: heat makes stomach pains worse | |

| | | "So I have been quiet and I realise like I don't want to complain: do that to myself just…what's going on so Digest…digestion time always difficult on a bike, I ate a bit fast, it's hot, I just went climbing, now it is flat it is easier so feeling a bit better, a lot of water in my stomach so, it's getting a bit better the stomach but was good all my attention was concentrated on my stomach, now I am trying to find some diet coke cos they say like it help the stomach and it's got caffeine" | |
|---|---|---|---|