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Development and Initial Validation of the Endurance Sport Self-efficacy Scale (ESSES)

Paul A. Anstiss[1], Carla Meijen[2], Daniel J. Madigan[3], Samuele M. Marcora[1]

1. School of Sport and Exercise Sciences, University of Kent, United Kingdom
2. School of Sport, Health, and Applied Science, St Mary's University, United Kingdom
3. School of Sport, York St John University, United Kingdom

Corresponding Author: Paul A. Anstiss, School of Sport and Exercise Sciences, University of Kent, Medway Campus, Chatham, Kent, UK, ME4 4AG. Email; pa298@kent.ac.uk.

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Abstract

Self-efficacy is likely to be an important psychological construct for endurance sport performance. Research into the role of self-efficacy, however, is limited as there is currently no validated measure of endurance sport self-efficacy. Consequently, the purpose of the present research was to develop and validate the Endurance Sport Self-Efficacy Scale (ESSES). In Study 1, an initial item pool was developed following a review of the literature. These items were then examined for content validity by an expert panel. In Study 2, the resultant 18 items were subjected to exploratory factor analyses. These analyses provided support for a unidimensional scale comprised of 11 items. Study 2 also provided evidence for the ESSES's convergent validity. In Study 3, using confirmatory factor analyses, further support was found for the 11-item unidimensional structure. Study 3 also provided evidence for the ESSES's convergent and concurrent validity. The present findings provide initial evidence that the ESSES is a valid and reliable measure of self-efficacy beliefs in endurance sports.

Keywords: endurance, performance, belief, questionnaire, efficacy

Introduction

Endurance sports are characterised by the performance of continuous, dynamic, and whole-body exercise tasks (Burnley & Jones, 2007). These tasks are commonly seen in activities such as running, cycling, and swimming, or in a combination of these (e.g., triathlon). The duration of these events can range from minutes to days. During these periods, endurance athletes must maintain high levels of effort and perseverance in order to counteract both physical and cognitive fatigue (Marcora, Bosio, & de Morree, 2009; Marcora, Staiano, & Manning, 2009). Alongside persevering with fatigue, endurance athletes must also engage in effective self-regulation strategies relating to pacing (Renfree, Martin, Micklewright, & St Clair Gibson, 2014), attention (Brick, MacIntyre, & Campbell, 2014), and coping (Kress & Statler, 2007; Zepp, 2016). A recent review identified several psychological determinants of endurance performance (McCormick, Meijen, & Marcora, 2015). One key psychological factor highlighted by McCormick et al.'s review, and which has been consistently linked with self-regulation, attention, and coping, is self-efficacy (Bandura, 1997).

Self-Efficacy

Self-efficacy refers to the "belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p.3) and represents the behaviours and skills an individual believes they can successfully perform. Importantly, self-efficacy beliefs are not just in reference to the skills or abilities an individual possesses but rather what they believe they can do with them (Bandura, 1997). For example, an athlete may possess a high level of physical fitness, but if they do not believe they are capable of utilising this fitness in a competitive environment it will count for little towards their self-efficacy.

Self-efficacy beliefs are formed through a series of cognitive processes involving the selection, interpretation, and integration of several sources of information (Bandura, 1997).

These sources include past performance experiences, vicarious influences, social and verbal persuasions, and perceptions of physiological and emotional states (see Samson & Solmon, 2011 for a review). In addition to an understanding of the task demands and the perceived ease and difficulty of the task, these sources will help provide an individual with an understanding of their own capability (Gist & Mitchell, 1992).Once these beliefs are formed they can have a powerful effect on an individual's cognitions and behaviour. For example, individuals high in self-efficacy typically set more challenging goals (Locke & Latham, 2002), put more effort into tasks (Hutchinson, Sherman, Martinovic, & Tenenbaum, 2008), and are more willing to persevere when faced with difficulties (Feltz, Short, & Sullivan, 2008).

Self-Efficacy and Endurance Performance

Self-efficacy has been associated with better performance in several endurance sports. Burke and Jin (1996) reported that self-efficacy was a stronger positive predictor of Ironman triathlon performance than performance history, maximal oxygen consumption, and sport confidence. Similairly, Okwumabua (1985) reported that pre-event self-effiacy explained 40% of the variance in marathon performance. Other studies have also established that self-efficacy is associated with better performance in track running (LaGuardia & Labbé, 1993), cross country running (Martin & Gill, 1995) and swimming (Miller, 1993).

There exist several possible psychological and physiological mechansisms through which self-efficacy may enable better endurance performance. On a psychological level, both perception of pain (Astokorki & Mauger, 2014; Mauger, 2014) and perception of effort (Marcora, Bosio, & de Morree, 2008) have been suggested to be key determinants of endurance performance. Attesting to the possible role of self-efficacy in influencing these perceptions, self-efficacy has been associated with improvements in pain tolerance (Johnson, Stewart, Humphries, & Chamove, 2014) and also with reductions in perceptions of effort

(McAuley & Blissmer, 2000). On a physiological level, running economy and maximal oxygen consumption (VO2max) are two key physiological determinants of endurance performance (Joyner & Coyle, 2009). Again, self-efficacy has been associated with improvements in running economy (Stoate, Wulf, & Lewthwaite, 2012) and maximal oxygen consumtpion (Montes, Wulf, & Navalta, 2017).

Self-efficacy appears to be an important factor for endurance performance. The assessment of this importance, however, is contingent on being able to adequately measure relevant self-efficacy beliefs. Here several limitations are evident in the existing literature. First, previous studies have not followed recommendations for self-efficacy scale development (Bandura, 1997, 2006). For example, Stoate, Wulf, and Lethwaite (2012) measured self-efficacy using a scale which conceptualised self-efficacy in the form of “will” rather than “can”. This is problematic because “will” generally refers to an individual’s intention as opposed to an individual’s perceived capability (Bandura, 2006).

Second, for those studies which have employed multi-item scales, self-efficacy was typically assessed in terms of ascending or descending performance times (Burke & Jin, 1996; LaGuardia & Labbé, 1993) or distances (Bueno et al., 2008). Such scales are known as hierarchical self-efficacy scales (Feltz et al., 2008). Whereas this approach is common in sport and exercise settings, Feltz and colleagues (2008) cautioned against an overreliance on such scales as they result in an oversimplification of complex performances. Hierarchical scales are popular as they typically report high levels of scale score reliability (Feltz et al., 2008) and they do not require a deep understanding of the demands in that domain and, therefore, they can easily be adapted to various study designs and scenarios.

Whereas such scales have helped provide evidence for the link between self-efficacy and performance, they often possess limited practical benefit for practitioners, coaches, and athletes. For instance, two athletes could both perceive themselves as not capable of achieving a certain time for a race/to cover a certain distance in a given time. For one athlete, this may be due to the belief that they are unable to pace themselves appropriately, whereas for the other athlete this may be due to the belief they are not capable of tolerating exercise-induced pain. A hierarchical scale would not allow us to differentiate between these two reasons and instead would merely suggest that both athletes perceive themselves incapable of achieving that time or covering that distance. This approach thus limits the possibility of accurate interventions (Bandura, 1997; Feltz et al., 2008). The measurement of these behaviours and skills would be best served through the use of a non-hierarchical scale.

Non-hierarchical scales look to assess an individual's self-efficacy across the full range of subskills that underpin performance in that domain (Feltz et al., 2008). Given the similarities in the demands and determinants of performance across endurance sports (Brick, MacIntyre, & Campbell, 2016; McCormick et al., 2016; Renfree et al., 2014), it is likely that there are common subskills which underpin performance across all endurance sports. Therefore, the development of a endurance sport-specific scale would be beneficial because it would provide practical implications for the design and delivery of self-efficacy interventions, as well as allowing further exploration of both the theoretical determinants (e.g., coaching, task difficulty, perceived fatigue) and outcomes (e.g., perception of effort, perseverance, performance) of self-efficacy beliefs.

The Present Research

There is currently no validated non-hierarchical scale of self-efficacy for endurance sports. Given the potential importance of self-efficacy in endurance performance, the development of such a scale would be beneficial for both practical and theoretical reasons. Consequently, the aim of the present research was to develop the Endurance Sport Self-Efficacy Scale (ESSES) that measures self-efficacy specific to the endurance sport domain.

We also sought to provide preliminary evidence for the validity and reliability of the ESSES. In so doing, a series of three studies are presented.

Study 1

The purpose of Study 1 was for initial item and scale development. First, in line with Bandura's (2006) recommendations for self-efficacy scale development, factors relating to endurance performance were identified through literature searches and the research teams' own conceptual knowledge, and items relating to these factors were developed. Next, the items and scale were subjected to an expert panel for review in order to ensure high levels of content validity.

Method

Development of the Initial Item Pool

In the construction of self-efficacy scales, Bandura (2006) urged that scales should be specific to the chosen domain, and researchers should attempt to identify the key factors relating to performance in these domains. Once these key factors have been identified, items relating to these factors should be created allowing the measurement of specific self-efficacy beliefs. This approach can help promote a scale which demonstrates improved sensitivity to individual differences in self-efficacy beliefs and promotes a greater level of validity in that domain (Bandura, 2006).

Performance in endurance sport is a complex mixture of physical, technical, and psychological factors (Taylor et al., 1995). Relating to the physical factors, endurance athletes aim to ensure they are physically prepared for their endurance sport (Jones & Carter, 2000) and they aim to manage exercise-induced sensations such as exercise pain, injury pain, discomfort and exertion (Christensen, Brewer, & Hutchinson, 2015; Samson, Simpson, Kamphoff, & Langlier, 2017; Schumacher, Becker, & Wiersma, 2016). In regards to the technical aspect, endurance athletes must ensure they pace themselves appropriately to help ensure high levels of performance (Renfree et al., 2014), ensure appropriate technique and form (Novacheck, 1998), and they must also be able to maintain high levels of concentration to aid this and other related decision-making processes (Brick, MacIntyre, & Campell, 2014). Psychologically, endurance athletes must cope with a variety of stressors (Fletcher, Hanton, & Mellalieu, 2006; Martin, 2002; McCormick et al., 2016), and ensure they manage any unwanted thoughts (Holt, Lee, Kim, & Klein, 2014) and emotions (Lane & Wilson, 2011) which may impede their performance.

From these physical, technical, and psychological factors, and based on relevant literature, we developed an initial pool of 20 items. Following Bandura's (2006) guidance, we ensured that these items were related to behaviours and skills that were rooted in the context of performing in endurance sport. Rather than focusing on a specific situation, we instead opted for a general domain focus. Although several self-efficacy researchers have cautioned against attempts to measure ”general” self-efficacy which exists across domains (Bandura 1997; Maddux & Gosselin, 2003), domain specific self-efficacy scales are a common approach to conceptualisation and measurement of self-efficacy beliefs (Bandura, 2006; Feltz et al., 2008). In a sport setting the Coaching Self-efficacy Scale (Feltz et al., 1999), the Collective Team Efficacy Scale (Short et al., 2005), and the Refereeing Efficacy Scale (Myers et al., 2012) all utilise a similar domain approach. Furthermore the development of a more general domain scale can in turn inform and facilitate the development of more specific self-efficacy scales (e.g., a running self-efficacy scale, or triathlon self-efficacy scale). For example, the Coaching Self-efficacy Scale (Feltz et al., 1999) has been successfully adapted to be specifically focused on high school coaches (Myers et al., 2008) and youth sport coaches (Myers et al., 2011).

Additionally, whereas situation specific self-efficacy scales report greater predictive power for performance (Moritz et al., 2000), they in turn possess less generalisability, and instead can reflect more on the task and transient information (e.g. weather, perceptions of energy), rather than the underlying self-efficacy beliefs (Bandura, 2006). As the primary aim of the scale was not solely the prediction of performance, but instead to allow the examination of theoretical determinants and outcomes, we felt justified in adopting this general domain focus. In order to promote a high level of content validity, we operationalised self-efficacy in our scale through the use of 'can' (Bandura 2006). In regards to the response scale, we opted to use a 0-100 response scale separated with 10 point intervals. Such a scale is commonly used in self-efficacy research (Bandura, 2006; Feltz et al., 2008) and has been suggested to report higher levels of predictive power than those scales which use fewer intervals (Pajares, Hartley, & Valiante, 2001). Considering the general domain focus, the use of the word 'can' and the 0-100 response scale, the scale stem which proceeded the items was:

> "Below you will find a list of actions and skills that are important for endurance performance. When you are taking part in your endurance sport, how confident are you that can do the following things. In each case please rate your degree of confidence from 0 (cannot do at all) to 100 (completely certain can do)."

Expert Review

For the purpose of content validation, two steps were undertaken. First, and in line with best practice for the development of psychological questionnaires (e.g. Hill, Appleton, & Mallinson, 2016), the question stem, the initial list of items, and the response options was submitted to an independent panel of experts via email. The panel consisted of three academics and two endurance sport coaches. The three academics were from different institutions than the research team, and had published research either relating to endurance psychology (*n* = 2) or self-efficacy scale development (*n* = 1) in international peer reviewed journals. The two endurance sport coaches had 18 and 22 years of coaching in running and triathlon respectively. This step was conducted to obtain information on each item's perceived clarity and relevance, as well as highlighting any possible missed items (Dunn et al., 1999).

Alongside this, following institutional ethical approval, interviews were conducted to gain insight into how endurance athletes understood, processed, and responded to the question stem, generated items, and response options (Dietrich & Ehrlenspiel, 2010). This was deemed a particularly important aspect of the scale development, as endurance athletes would be the end-user of the scale. Six competitive endurance athletes (runners = 2, cyclists = 2, triathletes = 2), who had been competing in their endurance sport for an average of 11.85 years (*SD* = 2.81) were recruited at this stage. To facilitate this process of understanding, verbal probing was employed. Verbal probes were aimed at comprehension and interpretation (e.g., what does this mean to you?), and at judgment and decision making (e.g., how did you arrive at your answer?).

Results and Discussion

Comments from the expert panel supported the inclusion of 17 of the 20 items submitted. Two items were suggested to be removed due to perceived similarity (e.g., 'Taper appropriately' was deemed too similar to 'Prepare physically' and therefore 'Taper appropriately' was removed), and one item was removed due to a perceived lack of relevance across endurance sports ('Deal with difficult terrain'). Additionally, feedback from the expert panel suggested the splitting of one item "Ensure appropriate nutrition and hydration" into two separate items - "Ensure appropriate nutrition" and "Ensure appropriate hydration". Although some further items were recommended for inclusion into the scale (e.g., Respond to other competitors pacing decisions), we decided against this, as we felt that these were not common across the endurance sport domain. The scale stem and response scale were deemed to be satisfactory.

The interviews with the athletes suggested that the scale was clear and measured appropriate factors relating to endurance performance. When probed about the reason they gave the answers they provided, the athletes stated that they did so based on their own prior experiences. As self-efficacy beliefs are hypothesised to primarily be determined through prior experiences (Bandura, 1997), we took this as an indication of appropriate content validity. Overall this process resulted in an 18-item scale, named the 'Endurance Sport Self-efficacy Scale' (ESSES), which covered a range of different behaviours and skills relating to endurance performance.

Study 2

The primary purpose of Study 2 was to explore the factor structure and scale score reliability of the 18-item version of the ESSES. The secondary purpose was to provide evidence for the initial convergent validity of the ESSES. This was achieved via an examination of its relation with other validated self-efficacy scales.

Method

Participants and Procedures

Following institutional ethical approval, participants completed an online survey, hosted on the Bristol Online Survey system and were recruited either through social media (Facebook and Twitter) or emails to endurance sport clubs. Three hundred and forty three (233 male, 108 female, 2 other) participants completed the survey. The mean age was 38.42 years (*SD* = 14.29) and participants had been taking part and competing in their endurance sport for an average of 10.97 years (*SD* = 12.29). Of the 343 participants, 137 were runners, 52 were rowers, 50 were triathletes, 49 were cyclists, 49 were swimmers, and 7 were 'other'. These 'others' consisted of three cross country skiers, two race-walkers, and two participants who did not specify their endurance sport.

Measures

The 18-item ESSES was administered with the same question stem and response format as listed during Study 1. As there are no other validated measure of endurance self-efficacy, we opted to use other measures which we hypothesised would be correlated with endurance self-efficacy in order to assess the convergent validity of the ESSES. The following four instruments were used:

General Self-Efficacy Scale (GSES). The GSES is a 10-item scale that is designed to assess optimistic self-beliefs to cope with a variety of difficult demands in life (e.g. “I can solve most problems if I invest the necessary effort”) (Schwarzer & Jerusalem, 1995). Participants responded to each item on a four-point Likert scale which ranges from 1 (Not true at all) to 4 (Exactly true). The scale reported acceptable scale score reliability ($\alpha = .78$).

Coping Self-Efficacy Scale (CSES). The CSES is a 26-item scale that is designed to assess a person's perceived ability to cope effectively with life challenges and to employ effective use of coping strategies (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006). It has three subscales: use of problem-focused coping (e.g. “I can make a plan of action and follow it when confronted with a problem”), use of emotion-focused coping (e.g. “I can keep from feeling sad), and received social support (e.g. “I can get friends to help me with the things I need”). Participants responded to each item on a ten-point scale ranging from 1 (Cannot do at all) to 10 (Completely certain can do). All the subscales were internally consistent ($\alpha = .77$ — $.85$).

Barriers to Training Self-Efficacy Scale (BTSES). The BTSES is an 18-item scale (Bandura, 2006) that is designed to assess a person’s perceived ability to maintain training when faced with various stressors (e.g. “After recovering from an injury that prevented me from training”). Participants responded to each item on an eleven-point scale ranging from 0 (Cannot do at all) to 100 (Completely certain can do). Good levels of internal consistency were reported ($\alpha = .91$).

Athletic Coping Skills Inventory (ACSI-28). The ACSI-28 is a 28-item scale that is designed to measure coping use and effectiveness in athletes (Smith, Schutz, Smoll, & Ptacek, 1995). It comprises seven sport specific subscales: coping with adversity (e.g. “I handle unexpected situations in my sport very well”), peaking under pressure (e.g. “To me, pressure situations are challenges that I welcome), goal setting and mental preparation (e.g. “I set my own performance goals for each training”), concentration (e.g. “It is easy for me to direct my attention and focus on a thing”), freedom from worry (e.g. “I worry quite a bit about what others think of my performance”), confidence and motivation (e.g. “I feel confident that I will perform well”), and coachability (e.g. “I improve my skills by listening carefully to advice and instruction from coaches and peers”). Participants responded to each item on a four-point scale ranging from 0 (Almost never) to 3 (Almost always). All the subscales were internally consistent (α = .72 — .93).

Data Analysis

In order to ascertain the factor structure of the ESSES, exploratory factor analysis (EFA) was conducted in line with common recommendations (e.g., Costello & Osborne, 2005; Fabrigar et al., 1999; Tabachnick & Fiddell, 2007). Factor solutions and retention was explored using principal axis factoring (PAF) with a promax rotation, and was assessed using parallel analysis (using O’Connor, 2000). PAF was chosen as it is not dependent on assumptions of multivariate normality (Costello & Osborne, 2005). A promax rotation was chosen as self-efficacy beliefs are hypothesised to be correlated (Bandura, 1997). Such a rotation is commonly used in self-efficacy scale development (e.g., Chesney et al., 2006; Feltz et al., 1999). Factor solutions were then assessed upon theoretical interpretability, structural and pattern coefficients (> .40), interpretability of cross-loadings, and communalities (> .20) (Tabachnick & Fiddell, 2007).

Reliability was assessed using Cronbach's α (Kline, 1998). Initial convergent validity was assessed using correlational analysis between the ESSES, GSES, CSES, BTSES, and ACSI-28. Cohen's (1992) guidelines of small (r = .10), medium (r = .30), and large (r = .50) were used when interpreting correlations.

Results and Discussion

Exploratory Factor Analysis

The initial analyses based on the parallel analysis suggested the possibility of either a one, two, or three factor solution (actual $\lambda 1$ = 6.19, $\lambda 2$ =1.42, $\lambda 3$ = 1.27 vs. $\lambda 1$ = 1.42, $\lambda 2$ = 1.34, $\lambda 3$ = 1.28 from parallel analysis). All possible factor solutions were investigated considering item-loadings and the theoretical interpretability of the factors. Ultimately, we decided to adopt a one factor (i.e. unidimensional) solution. This decision was based on several reasons. First, in all the possible factor solution combinations, most of the items primarily loaded onto the first factor. Second, the other items tended to display high levels of cross-loading with this first factor. Third, although both the second and third factors were theoretically interpretable, they were only formed from four and three items respectively.

In the process of scale refinement, we removed seven items. These items related to skills and behaviours that are carried out prior to performance (e.g. Item-16 "Prepare physically for demanding events"). Once removed, the unidimensional scale related to a variety of behaviours and skills which are carried out during endurance sport performance. This included behaviours and skills relating to psychological factors (e.g. Item-8 "Manage my thoughts during events), physical factors (e.g. Item-1 "Deal with non-injury related pain), and technical factors (e.g. Item-12 "Pace myself appropriately").The final 11-item one-factor solution is presented in Table 1.

Reliability and Validity

After establishing the factor structure of the ESSES, the next stage was to assess the reliability and validity of the scale. In terms of scale score reliability, the ESSES displayed acceptable Cronbach's alpha (α = .88). In terms of convergent validity, correlations between the ESSES, the CSES, GSES, BTSES, and ACSI-28 are presented in Table 2. Examination of the correlations between the ESSES and other scales revealed significant positive relations, and these relations were typically medium and medium-to-large in size. This provides initial evidence for the convergent validity of the ESSES.

In conclusion, Study 2 provided initial evidence for the ESSES as a measure of self-efficacy for endurance sport. The unidimensional scale demonstrated good levels of scale score reliability and convergent validity.

Study 3

Study 3 had two aims. First, we aimed to confirm the 11-item unidimensional structure of the ESSES using confirmatory factor analysis (CFA). Second, we aimed to provide further evidence for the validity of the ESSES. Specifically, we assessed the scale for concurrent and criterion-related validity, by examining the relation between marathons completed and maximal oxygen uptake (VO2max) with the ESSES, using structural equation modelling (SEM).

Method

Participants and procedures

As in Study 2, following institutional ethical approval, participants completed an online survey which was hosted on the Bristol Online Survey system. Participants were recruited through social media (Facebook & Twitter) and contacting endurance sport clubs in the United Kingdom.

Participants for Study 3 consisted of two samples. Sample 1 consisted of 115 marathon runners (89 males) with a mean age of 39.84 years (*SD* = 10.25) who had been competing in distance running for 12.47 years (*SD* = 11.59). Sample 2 consisted of 105 endurance athletes (63 males) with a mean age of 42.38 years (*SD* = 11.78). Thirty six of the endurance athletes were runners, 17 were cyclists, 45 were triathletes, five were swimmers and three were racewalkers. The athletes had been competing in their endurance sport for an average of 11.32 years (*SD* = 10.03).

Measures

The 11-item ESSES was administered with the same question stem and response format as listed during Study 1 and Study 2. In addition, in Sample 1, marathon runners were asked to indicate their completed number of marathons. The purpose of this was to help provide criterion validity for the ESSES, as experience is hypothesised to be a key determinant of self-efficacy beliefs (Bandura, 1997).

For Sample 2, participants were asked questions to estimate VO2max. VO2max was estimated using formulas for men (Malek, Housh, Berger, Coburn, & Beck, 2005a), and women (Malek, Housh, Berger, Coburn, & Beck, 2005b). Reported age (years), weight (kg), height (cm), hours per week of exercise, duration that participants had consistently (no more than one month without exercise) been exercising (in years), and a typical session rating of perceived exertion (6-20 scale) was used to determine the VO2max. VO2max is the maximum capacity of the body to consume oxygen during maximal exertion and is considered an important physiological determinant in endurance performance (Joyner & Coyle, 2008). As a further measure of concurrent validity, we hypothesised that the ESSES would correlate with estimated VO2max

Data Analysis

Model fit was assessed via confirmatory factor analysis (CFA) using Mplus 8.0 (Muthén & Muthén, 2012) and robust maximum likelihood estimation. We used multiple indexes to assess model fit for the CFA: $\chi 2$(df) statistic, comparative fit index (CFI), tucker-lewis index (TLI), and root mean square error of approximation (RMSEA). The following criteria were indicative of acceptable model fit: >.90 CFI, >.90 TLI, and <.09 RMSEA (Marsh, Hau, & Wen, 2004). We then used SEM to examine the relation between the number of marathons completed, estimated VO2max, and scores on the ESSES in each of the relevant samples.

Results and Discussion

Assessment of Factorial Structure

Our initial CFA provided an adequate fit to the data ($\chi 2$(df) = 108.47(44) $p < .001$, CFI = .92, TLI = .90, RMSEA = .08). These findings provide further support for the 11-item unidimensional structure of the ESSES. Moreover, an examination of the standardised parameter estimates from the CFA indicated that all loadings were significant and meaningful (i.e. > .04). The factor loadings and uniquenesses of the CFA are reported in Table 3.

Validity

The results of the SEM based on Sample 1 revealed that the number of marathons completed significantly predicted scores on the ESSES ($\beta = .28$, $p = .025$). Additionally, the results of the SEM based on Sample 2 revealed that estimated VO2max significantly predicted scores on the ESSES ($\beta = .32$, $p = .001$). Taken together, these findings provide further evidence for the concurrent and criterion-related validity of the ESSES.

General Discussion

Self-efficacy is likely to be an important factor in endurance performance (e.g., Burke & Jin, 1996; LaGuardia & Labbé, 1992). To date, however, no non-hierarchical self-efficacy measure has been developed for the endurance sport domain. To address this deficit, we developed and validated the Endurance Sport Self-Efficacy Scale (ESSES). Through three rigorous studies, aligned with best psychometric practice, we derived an 11-item scale that assesses self-efficacy beliefs related to endurance performance.

The ESSES captures the breadth of physical, psychological, and technical facets associated with endurance performance. For example, the management of exercise induced sensations is often identified as a key demand of endurance performance in both quantitative and qualitative research (Astokorki & Mauger, 2016; Marcora, 2009; McCormick et al., 2016; Simpson, Post, Young, & Jensen, 2014). Similarly, intrusive thoughts and unwanted emotions are commonly reported by endurance athletes and may interfere with performance (Holt, Lee, Kim, & Klein, 2014; Lane & Wilson, 2014). Self-efficacy to control and manage exercise induced sensations and intrusive thoughts and emotions is likely to be an important factor in understanding and enhancing endurance performance.

Although endurance performance is underpinned by several different performance-related facets, the ESSES was found to be unidimensional. This may be because of the overlap that exists between the facets associated with endurance performance. For instance, exercise-induced sensations have been demonstrated to be related to pacing decisions, ability to maintain concentration, and the occurrence of unwanted thoughts and emotions (Mauger, 2014; McCormick, Meijen, Anstiss, & Jones, 2018; Whitehead et al., 2017). This level of overlap between the facets, means that it is unlikely to identify distinct separate factors, and that instead the ESSES can be best understood as relating to behaviours and skills which occur during performance. It is this level of overlap that also resulted in the removal of seven items generated in Study 1 that related to preparatory aspects of endurance performance. As the goal of the current research was to develop a self-efficacy scale for endurance sport performance, not preparation, we do not consider this to be a major limitation.

Our findings illustrate that the ESSES may be a reliable and valid measure. Regarding reliability, we consistently reported high levels of scale score reliability. In addition, several forms of validity were supported. For convergent validity, endurance sport self-efficacy correlated positively with related self-efficacy beliefs (e.g. barriers to training) and use of coping skills during competition. This is line with research that has demonstrated that self-efficacy is associated with the use and maintenance of adaptive coping strategies during competition (Kane et al., 1996). Regarding concurrent validity, in line with previous research (e.g., Okwumabua, 1985), the number of marathons an athlete had completed predicted ESSES scores. This provides further evidence for the association between self-efficacy and prior experiences. This is important because prior success is hypothesised to be the key source of self-efficacy (Bandura, 1997; Feltz et al., 2008). Regarding criterion-related validity, estimated VO_{2max} was a significant predictor of endurance sport self-efficacy. Because of the physiological demands of endurance sports (Joyner & Coyle, 2009), the possession of high levels of physical fitness (e.g., high VO_{2max}), are likely to lead to increased perceived capability. This provides further support for research linking levels of physical fitness and self-efficacy (Caruso & Gill, 1992).

Limitations and Future Research

The present research has two main limitations. First, our measure was derived from cross-sectional data. This meant that we were unable to provide evidence for criterion or predictive validity. It also meant that we could not examine test-retest reliability. To address these issues, researchers should examine the predictive, criterion and test-retest reliability validity of the ESSES in future studies. Second, for all three studies, we used convenience sampling. Whereas this is common practice for research in sport, it may have biased the sample (i.e., resulted in only individuals who already had an interest in the psychological aspects of endurance performance participating in the study). In the same vein, it may be possible that endurance athletes with low levels of self-efficacy, such as novices, lacked a strong athletic identity (Brewer, Van Raalte, & Linder, 1993), which may have meant that they would not have considered themselves “endurance athletes”, and therefore they would not have participated in the current research.

These limitations aside, the ESSES could make a valuable contribution to future self-efficacy research. In recent years, there has been an increased focus on the self-efficacy-outcome relationship at the within-person level (Gilson, Chow, & Feltz, 2012). The ESSES could be used to examine the relationship between self-efficacy and various outcomes such as performance, coping, and satisfaction. We are particularly interested to see how these variables change across a competitive season. This would help provide valuable insight into the malleability of self-efficacy beliefs and provide evidence for how they may change in response to factors such as training, tapering, and competitive performances (Feltz et al., 2008).

Alongside these directions for future research, the ESSES can act as a useful tool for practitioners, coaches, and athletes. Given the strength of the relations between self-efficacy and performance (Moritz et al., 2000), high levels of self-efficacy are likely to be desirable for athletes. The ESSES provides practitioners and coaches with the opportunity to identify low and/or weak self-efficacy beliefs relating to endurance performance. This can help provide the opportunity for more targeted interventions. Such interventions may result in greater performance benefits than common “one-size-fits-all” approaches (cf. McCormick et al., 2018).

Conclusion

The present research provides initial evidence for the validity and reliability of the 11-item Endurance Sport Self-Efficacy Scale (ESSES). The ESSES is the first non-hierarchal self-efficacy scale developed specifically for the endurance sport domain. Consequently, the

ESSES provides researchers, practitioners, coaches, and athletes with a means to assess and understand self-efficacy beliefs in endurance sport.

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