CAN WE EVIDENCE-BASE INJURY PREVENTION AND MANAGEMENT IN WOMEN'S FOOTBALL? A SCOPING REVIEW

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CAN WE EVIDENCE-BASE INJURY PREVENTION AND MANAGEMENT IN WOMEN'S FOOTBALL? A SCOPING REVIEW

ABSTRACT

This review aimed to scope literature on any level of competitive football for women, to understand the current quantity of research on women's football injuries to understand where research is currently focused as part of a larger FIFA project aiming to steer women's football research. The study reviewed all medicine (injury) related papers scoped by Okholm Kryger et al. (2021) and an updated search was performed on 23/02/2021. Eligibility criteria assessment followed the Okholm Kryger et al's (2021) study with injury specific research focus. A total of 497 studies were scoped. The majority of studies contained an epidemiological (N=226; 45%) or risk factors assessment (N=105; 21%). Less assessed areas included financial burden (N=1; <1%) and injury awareness (N=5; 1%). 159 studies (32%) assessed injuries of the whole body. The most common single location assessed in the literature was the knee (N=134, 27%), followed by head/face (N=108, 22%). These numbers were, however, substantially lowered, when subdivided by playing level and age group. The volume of research focuses especially on descriptive research and specific body locations (head/face and knee). Although information can be taken from studies in other sports, more football specific studies to support management and prevention of injuries are warranted.

Keywords: female, girls, ladies, soccer, evaluation, injuries

INTRODUCTION

Women's football (soccer) is currently in a boom of popularity and is one of the most popular sports for women and girls today (UEFA, 2017). Globally there are more than 13 million playing organised football and there are 945,068 female adult players officially registered with the Fédération Internationale de Football Association (FIFA; FIFA, 2014).

In parallel with an increasing rise in participation and recognition from international governing bodies (FIFA 2014, 2016, 2020; UEFA, 2016, 2017), women's football has also received increased attention from sports researchers around the world, though far from comparable to their male counterparts (Pfister, 2015; Okholm Kryger *et al.*, 2021). Injury prevention and the management of injuries i.e. rehabilitation are particularly hot topics in football and sports in general. However, while injuries in men's football has been widely researched (Kirkendall, 2020), it is unlikely that applying what we know from men's football to the women's game will provide us an accurate and comprehensive understanding of the women's side of the story, as football injuries, and injury burden, differ between male and female players (Larruskain *et al.*, 2018; Waldén *et al.*, 2018; Werner *et al.*, 2019). In addition, female-biased conditions believed to impact injury risk exist including hormonal fluctuations during the menstrual cycle and disordered eating (Waldén *et al.*, 2018; Martin *et al.*, 2021).

A systematic approach to implement the best of research and practice-based evidence to make quality decisions has been proposed for sports medicine decision making in the practical setting (Finch, 2006; Ardern *et al.*, 2019b). The three step approach is suggested: (1) to systematically review published literature, including its quality, (2) to combine the published evidence with quality clinical evidence, and (3) to consider its feasibility of use in the given practical setting (Ardern *et al.*, 2019b). An understanding of current research focus and gaps in the literature are therefore essential.

This study is a follow up from a larger scoping review performed on all literature published on all aspects of women's football (Okholm Kryger *et al.*, 2021). Injury related literature in particular showed a yearly increase in research outputs with a total of 442 papers identified (Okholm Kryger *et al.*, 2021). A further sub-categorisation of this injury related literature will help guide researchers to which areas are lacking attention to allow for evidence-based practice when assessing, managing, preventing and educating around injuries in women's football at all levels and in all age groups. Therefore, the aim of this study was to scope the available peer-reviewed literature published in English, French, German, and Spanish (i.e., the official FIFA languages) on any level of competitive football for women, to understand the current quantity of research on women's football injuries.

METHODS

The protocol for this scoping review was pre-registered on Open Science Framework (osf.io/gp7fb). The study followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist (Tricco *et al.*, 2018) as well as the recommended best practise guidelines for scoping reviews by Levac et al. (2010) The search strategy and study selection methodology are previously described in the larger scoping review performed on all literature published on women's football (Okholm Kryger *et al.*, 2021). The following keywords were therefore applied (*football* OR *soccer)* AND (*female** OR *woman* OR *women* OR *ladies* OR *lady)*. Five relevant databases were selected through researcher discussion and searched (PubMed (1966–2019), PsycINFO (1967–- 2019), Web of Science (1900–2019), Scopus (1788–2019), SPORTDiscus (1892–2019)). The first search was conducted on 15 December 2019, and was updated 23 Februrary 2021 for this study following the original procedure (Okholm Kryger *et al.*, 2021) but soley scoping for injury related articles.

Data extraction

To standardise level of play and age, grouping of descriptions was applied (Table 1 and 2). The extracted articles on injury specific data were grouped based on injury location using the Fuller et al. (2006) consensus statement on injury definitions in football. Injury related studies were further subcategorised by the research topic (Table 3). The topics discovered were further sub-categorised as descriptive, proactive and reactive research defined as (1) 'descriptive' research establishes how often injuries occur, (2) reactive research focuses on handling the injuries that have occurred, (3) proactive research focuses on aiding understanding of how, why and in which situational circumstances certain injuries occur and strategies targeting the mitigation of injury occurrence (Figure 1).

****** Table 1 near here******

****** Table 2 near here******

****** Table 3 near here******

****** Figure 1 near here******

Data charting

The data were compiled in a single Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, WA). Data were charted in Tableau (Mountain View, Seattle, WA) using bar charts for categorical data (injury location, research topic, playing level and age group). Categorical data of injury location, research topic, playing level and age group were also assessed using multilevel content evaluation, which was charted using bar charts. For multilevel content evaluation, it must be noted that studies may have assessed multiple injury locations, topics, playing levels and/or age groups. For example, if a study investigated a knee prevention

programme and its relationship with injury mechanisms in elite and recreational players, it was assigned to both elite and recreational playing level as well as both mechanism and prevention programme topics. The study would in this case appear under both elite and recreational playing level for both mechanism and prevention programme topic and hence not represent to total number of studies conducted in the literature.

RESULTS

The updated online search of the five mentioned databases yielded 3,936 results (Figure 2). After removal of duplicates using Mendeley, 2,444 titles and abstracts were screened. A total of 79 articles remained after the title and abstract screening. After checking for duplicates from the original search a total of 55 new papers were included. These were added to the 442 originally scoped articles, summing up to a total of 497 articles scoped for this study (Figure 2; Appendix 1).

****** Figure 2 near here******

Injury topic focus

From all 497 injury focused studies, the topic, using the definitions detailed in Table 3, revealed the majority of studies contained descriptive epidemiological assessment (N=226, Figure 3) followed by risk factors (N=105, Figure 3). Less assessed areas included cost (N=1, Figure 3) and injury awareness (N=5, Figure 3). In a chronological injury event order, the mechanism of injury was addressed in 37 studies, assessment of injury in 74 studies and the management of the injury in 68 studies, whilst the return to play was addressed in 16 studies. Methods of injury prevention were addressed 31 times using a training programme and ten times using other proposed strategies.

****** Figure 3 near here******

Injury location focus

From all injury focused studies, the location in accordance to the Fuller et al. (2006) consensus statement on injury definitions revealed 159 studies (32%) reviewing injuries of the whole body (Figure 4). These studies commonly presented descriptive epidemiological data (Figure 5). The most common single location assessed in the literature was the knee (N=134, 27%), of which, 89 (18%) included the word anterior cruciate ligament injuries or ACL in their abstracts. Studies with a knee injury focus varied in themes (Figure 5). The second most common single location involved the head/face (N=108, 22%), of which, 96 (19%) studies included the word concussion in their abstract.

****** Figure 4 near here******

****** Figure 5 near here******

Injury location focus by topic, playing level and age group

Data was further broken down to identify how research focus on the different injury locations and topics were evaluated within population specific metrics (playing level and age group). A large spread was seen for ***whole body*** assessments, where descriptive epidemiological research predominantly focused on recreational pre-seniors (N=28, Figure 6a) and seniors (N=25, Figure 6a), although a high proportion of studies did not declare the playing level and age group assessed within their abstract or title (Figure 6a).

The ***upper limb*** was the least assessed body region with no more than three studies covering a topic within a specific injury location for a given playing level and age group (Figure 6a-c).

These involved descriptive epidemiology of shoulder injuries in senior college and senior and pre-senior recreational players (Figure 6a). Multiple upper limb areas have not yet been covered by research (Figure 6a-c).

The ***head/face*** injures were predominantly studied in non-elite populations (Figure 6a) with the most studies conducted on descriptive epidemiology in senior college/university players (N=13) and recreational senior (N=11) and pre-senior populations (N=11, Figure 6a). The ***neck/cervical spine*** and ***core*** region injuries were not assessed by more than three studies within the given topic, playing level and age group (Figure 6a-c). Multiple neck/cervical spine and trunk areas have not yet been covered by research (Figure 6a-c).

The ***lower limb*** was the most assessed body region with the knee region demonstrating a broad spread in research topics covered for the different playing levels and age groups (Figure 6a-c). On the contrary, areas not yet covered by research include injury mechanism of non-knee lower limb injuries and limited research is currently available on most non-knee related injury regions of the lower limb, when divided by playing levels and age groups (Figure 6a-c).

****** Figure 6a near here******

****** Figure 6b near here******

****** Figure 6c near here******

DISCUSSION

This study aimed to scope the available peer-reviewed, FIFA language literature on women's football injuries. The current volume of research proved to be limited with focus given mainly to a few specific research topics and body locations. Yet tendencies showed attention given to both elite and recreational players within those research topics and body locations. Disability players have, however, not been a common population featured in research studies.

Descriptive research

From the 497 studies in this scoping review nearly half (N=226; 45%) of all studies were related to descriptive epidemiology. These descriptive epidemiological studies predominantly focused on the whole body (N=117; 52%), head or face (N=40; 18%) and knee (N=34; 15%). On the contrary, only 37 of all identified studies (7%) were found to assess the mechanism of injuries, which, again, predominantly focused on the whole body (N=4; 11%), head or face (N=24; 65%) and knee (N=7; 19%). An attempt has therefore been made by researchers to understand 'how many' injuries occur. Systematic reviews on injury epidemiology in women's football exist (Alahmad, Kearney and Cahalan, 2020), however, it is debatable how accurately a systematic review of current literature reflects current tendencies in football due to the rapid changes to the game. A large impacting factor to consider when reviewing injury describing research is the rapid physical and tactical development occurring with the professionalisation of the women's game (FIFA, 2019). Hence, caution with the interpretation of older research is needed.

Reactive and proactive research

Reactive research was covered by 67 injury assessment studies (15%), 60 injury management studies (14%), 15 return to play studies (3%), 14 long-term impact studies (3%) and a single cost focused study (<1%). When these are further broken down by body region, playing level and age group, the numbers drastically decreased, demonstrated by the most commonly researched reactive research injury topic 'injury assessment' maximally reaching a cover of five studies. Similarly, proactive research demonstrated limited studies available in the literature with 88 studies exploring risk factors (20%), three studies on injury awareness (<1%) and 25 and eight studies on injury programmes and strategies, respectively (6% and 2%). When

these, again, are further broken down by body region, playing level and age group, the numbers drastically decreased the most commonly researched proactive strategy topic 'risk factors' was maximally covered by seven studies for knee injuries in pre-senior recreational players. A recent meta-analysis systematically reviewed the efficacy of preventive programs on injury incidence in any women's football code (e.g., rugby, football and American football; Crossley *et al.*, 2020). However, the authors combined studies from different competitive levels (community to professional), age (from under 13 to adults), football codes, and sex (mixed in some studies). This review also identified a high risk of bias in all but one of the included studies. Caution should be made when drawing conclusions by merging different sports but equally when merging playing levels, age groups, and aging studies which are quickly outdated due to the vast development of women's football. The present scoping review therefore suggests that more primary research is needed before systematic reviews and meta-analysis can attempt to summarise on optimal injury management strategies.

Body location focus

A large discrepancy was seen in research attention for different body locations. The head and knee were the most commonly researched body parts, whilst recent epidemiological research on elite seniors identified the anterior thigh (Mayhew *et al.*, 2018) as the most common injury location. Epidemiological research on elite and non-elite pre-seniors has identified the ankle as the most common injury location for both recreational and elites (Söderman *et al.*, 2001; Le Gall, Carling and Reilly, 2008; Martín-San Agustín *et al.*, 2021). A limited amount of research is therefore available for medical staff to make a quality decision for sports medicine related practices on the most commonly injured locations (Ardern *et al.*, 2019b, 2019a). It should, of course, be acknowledged that some generic research can be used across sports, though sports specificity is needed in areas such as injury mechanism or return to play. The increased

research focus is, instead, likely due to the time-loss caused and risks of not returning to sport associated with head (Stone *et al.*, 2017; Vedung *et al.*, 2020) and knee (Roos *et al.*, 1995; Waldén *et al.*, 2011; Fältström, Hägglund and Kvist, 2016) injuries in women's football. Yet despite the research focus, injury rates remain high and in particular, higher than their male counterparts (Mayhew *et al.*, 2018; Gupta *et al.*, 2020; Kontos *et al.*, 2020; Vedung *et al.*, 2020), indicating that a better understanding and hence more research is still needed – even in areas receiving higher levels of attention (Lislevand *et al.*, 2014). Concussion reactive and proactive research is also lacking for all sports as new and more sensitive assessment methods are being implemented, treatment practice is changing and the long-term impacts are being reviewed (McCrory *et al.*, 2013, 2017; Nordström, Nordström and Ekstrand, 2014; Patricios *et al.*, 2017; Asken *et al.*, 2018; Jackson and Starling, 2019).

Strengths and limitations

Our scoping review followed the PRISMA-SR Checklist (Tricco *et al.*, 2018) as well as the recommended best practice guidelines for scoping reviews by Levac et al. (2010). In our study, we searched five databases and scoped for peer-reviewed studies written in four languages. Yet, it must be acknowledged that studies not retrievable from these databases are not included in this study. Additionally, studies not identifying the sport and/or the sex of the athletes were excluded during the screening process. A large proportion of studies also lacked clarification on playing level and age group assessed in the study. The authors manually classified the studies into topics, which although screened by two independent reviewers may have introduced bias. Finally, it was not possible to identify the geographical origin of the papers published and caution should be made when generalising e.g., epidemiological trends from one geographical location to another due to known factors likely to alter injury rates such as

surfaces conditions (Fuller *et al.*, 2007a, 2007b), match schedules (Huggins *et al.*, 2020), and training load/styles (Huggins *et al.*, 2020).

CONCLUSION

The volume of research proved to be heterogeneous and limited with focus given especially to descriptive research and the head/face and knee locations. Additionally, cautions should be made when reading or systematically reviewing literature as it quickly outdates due to the vast development of women's football. Studies to enhance the understanding and application of preventive or treatment strategies for injuries are lacking, making it difficult for medical staff to make evidence-informed decisions for injury prevention and management. Our scoping review therefore suggests that research groups and practitioner scholars focus research efforts on understanding injury mechanisms, risk factors, inform design and execution of preventive strategies and guide the return to play process of injuries in women's football at all levels and in all age groups.

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KEY POINTS

- Female football injury research is predominantly composted of epidemiological research.
- Discrepancies in research focus is seen between body regions – with knee and head/face attracting the most attention.

- Less research focuses on management of commonly faced injuries dealt with in day-to-day practice – e.g., thigh strains and ankle sprains.
- It is challenging for clinicians to evidence base injury prevention and management strategies of certain injury types due to lack of research.

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Figure 1. Relevance of football injury research topics

Figure 2. Flow chart of study inclusion process of the repeated search performed.

Figure 3. Injury topics addressed in previous literature.

Figure 4. Body part addressed in previous injury-focused literature.

Figure 5. Injury topics addressed by injury location in previous literature.

Figure 6a. Head/Face, neck and core focused research divided by research topic, playing level and age group.

Figure 6b. Upper limb focused research by research topic, playing level and age group

Figure 6c. Lower Limb focused research by research topic, playing level and age group.