Injury risk and prevention strategies in amateur women's soccer

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Injury risk and prevention strategies in amateur women's soccer

By

Tahani Alahmad

A thesis submitted in fulfilment of the requirements for the degree of: Doctor of Philosophy at the University of Limerick

Supervised by

Dr Amanda Clifford and Dr Audrey Tierney

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Abstract

Title: Injury risk and prevention strategies in amateur women's soccer

Author: Tahani Alahmad

Background: A substantial increase in amateur women's soccer participation is associated with increased injuries. Studies investigating injury in this cohort are few. Gender, age, and regional differences may limit the generalisation of findings from other studies.

Aim: To explore the injury risk profile, players' opinions about injury risk and prevention, and the uptake of prevention measures among amateur women soccer players. The first objective was to synthesise the evidence regarding risk factors for injury in women's soccer; the second was to investigate injury profile, the prevalence of risk factors and players' opinions on injury risk and prevention. The third objective was to explore players' perceptions of injury risk and prevention and the barriers/facilitators to players' uptake of prevention strategies.

Methods: A systematic review was conducted to meet objective one; a cross-sectional study was conducted to meet objective two, and a qualitative study was conducted to meet objective three.

Results: A previous injury and joint hypermobility are the strongest injury predictors in elite women's soccer. The cross-sectional study showed a negative association between injuries and participants' general health (odds ratio = 0.820, 95% confidence intervals 0.7–0.9, p = 0.007). Half (50%, n = 67) of participants had received no education on injury risk or prevention. Most participants were not aware of certain risk factors, such as joint hypermobility and playing position. Three main themes were identified in the qualitative study: 1- "we don't have enough knowledge about injury prevention," 2- implementing injury prevention measures varies across players and teams, and 3- "we

love the game … but we are undervalued." Participants' biopsychosocial characteristics influenced their experiences in injury prevention in all themes.

Conclusion: This project provides valuable novel information about injury risk and prevention in amateur women's soccer, adding to the limited body of literature for this cohort. This thesis will inform future injury-prevention interventions tailored to amateur women soccer players and provide guidelines for future research to improve player safety.

Declaration

I declare that this thesis has been composed by myself the PhD candidate, Tahani Alahmad, under the supervision of Dr Amanda Clifford and Dr Audrey Tierney, and that it represents the results of the research undertaken. The first two stages of this project were conducted under the supervision of Dr Philip Kearney and Dr Roisin Cahalan between August 2017 and November 2019.

Where required, I have acknowledged the nature and extent of work carried out in collaboration with and/by others included in the thesis.

Tahani Alahmad

Signed: *Tahani Alahmad*

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Tahani Alahmad

Table of Contents

List of Publications

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Posters

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Poster display in the Health Research Institute (HRI) research week at the University of Limerick, 3–7 December 2018.

Alahmad TA, Kearney P, Cahalan R. Injury in elite women's soccer: A systematic review. Poster display at the Irish Society of Chartered Physiotherapists (ISCP) conference, 8–9 November 2019.

Online presentation

Injury prevention in women's soccer, via Zoom, 13 November 2020.

List of Tables

List of Figures

List of Abbreviations

Full name	Abbreviation
Anterior Cruciate Ligament	ACL
Athlete Sleep Screening Questionnaire	ASSQ
Body Mass Index kg/m^2	BMI
Critical Appraisal Skills Programme	CASP
Confidence Intervals	CI
Female Hormone Intake	FHI
Football Association Ireland	FAI
Federation International Football Association	FIFA
Hamstring to Quadriceps ratio	H/Q
Joint Hypermobility	JH
Kinesthetic Ability Trainer	KAT
Knee Injury Prevention Programme	KIPP
Not Applicable	N/A
Oxford Centre of Evidence-Based Medicine	OCEBM
Odds Ratio	OR
Prevent injury and Enhance Performance Programme	PEP
Profile of Mood States	POMS
Preferred Reporting Items for Systematic Reviews and Meta-Analyses	PRISMA

Rating of Perceived Exertion	RPE
Reflexive Thematic Analysis	RTA
Sport Competition Anxiety Test	SCAT
Standard Deviation	SD
Subjective health complaints	SHC
Theory of Planned Behaviour	TPB
Translating Research into Injury Prevention Practice	TRIPP
Total Mood Disturbance	TMD
Union of European Football Associations	UEFA
Women's Football Association of Ireland	WFAI

Glossary of terms

Adequate rehabilitation: The restoration of the anatomical and functional levels (required for return to play) of a previously injured body part.

Adherence: The players' uptake of prescribed/recommended injury-prevention measures that is influenced by their biopsychosocial characteristics, including their environment, beliefs, and resources.

Aggressive playing style: Any form of tactile or hostile aggressive behaviours that result in physical or psychological harm to the targeted (opponent) player aiming to win the ball (Gümüşdag, 2021).

Amateur player: "*One who competes for the love of sport and as a means of recreation, without any motive of securing any material gain from such competition*" (Henning and Krieger, 2020, p.13).

Anatomic location of injury: The body organ affected by injury, such as the head, shoulder, thigh, or ankle.

Attacker/Striker: A player who is positioned nearest to the opponent team's goal.

Compliance: The players' uptake of the prevention measure based on the recommended intensity, frequency, and duration without considering the biopsychosocial characteristics.

Contact injury: An injury that resulted from direct contact of a player's body part with another player or an object.

Cross-sectional study: Observational studies that analyse data from a population at a single point in time.

Culture: The knowledge and characteristics of a group of people, including their beliefs, food, social norms, daily habits, clothes, and religious practice.

Elite players: The best performers in their country in a certain sport who are competing at national or international levels.

External risk factors: Causes of injury that are external to the player.

Forward: Any player who is playing in an attacking position for the team.

Goalkeeper: A player who guards the team's goal from entering footballs.

Individual differences: Characteristics of the individual, including physical, physiological, psychosocial, and environmental aspects.

Injury prevention programme: An evidence-based set of neuromuscular exercises with specific components and duration to decrease the risk of injury to soccer injuries, such as FIFA 11+.

Injury prevention strategy/measure: A method, or group of methods, used to decrease the risk of injury, such as muscle stretching, adequate sleep, and warm up.

Injury type: The body tissue affected by injury, such as bone fracture, muscle strain, ligament sprain, or skin laceration.

Internal risk factors: Causes of injury that are internal to the player.

Midfielder: A player who plays in the middle of the field between the strikers and defenders.

Mild injury: A soccer-related injury that results in the absence of the affected player from soccer games and/or practice for 4–7 days.

Minimal injury: A soccer-related injury that results in the absence of the affected player from soccer games and/or practice for 1–3 days.

Moderate injury: A soccer-related injury that results in the absence of the affected player from soccer games and/or practice for 8–28 days.

New injury: The first injury incident during a soccer game or training session.

Non-contact injury: An injury that occurs without direct contact of a player's body part with another player or an object.

Non-time loss injury: A soccer-related injury that does not result in the absence of the affected player from soccer games and/or practice.

Overuse injury: An injury that has a gradual onset and no associated trauma.

Prospective study: A study that follows the occurrence of the outcome measure (soccer injury) among participants over a period of time (this outcome was not present before the study starts).

Q-angle: The angle formed between the quadriceps muscles and the patella tendon.

Recovery: A multi-layered process in which the body restores its balance at all levels (e.g., physiological, biological, psychological) after it has been disturbed by an internal or external factor such as sport-induced fatigue.

Recurrent injury: (The opposite of new injury) is a re-injury after four weeks or more from return to play, even if the player demonstrated complete healing from the original injury.

Referee: A person responsible for applying the rules of soccer during the match.

Regional differences: Characteristics related to a particular geographical region, such as climate and culture.

Retrospective study: In this study the outcome measure (soccer injury) has already occurred, and the researcher investigated data regarding the outcome from the participants, from involved staff, or from the participants' medical records.

Severe: A soccer-related injury that results in the absence of the affected player from soccer games and/or practice for more than 28 days.

Severity of an injury: The number of days lost from a soccer game and/or a practice session due to a soccer-related injury.

Soccer exposure: The accumulated training and match load on a player per week.

Soccer injury: An injury that occurs during a game or practice and results in the restriction of soccer-related activity for one-or-more days.

Soccer league: An association of football clubs that organises matches between teams at the same level.

Traumatic injury: An injury that has a sudden onset and is related to a trauma.

Women players: Adult female players of 18 years of age and older.

Chapter 1 Introduction

1.1 Prologue

This chapter provides a background to the topic of this thesis, "*Injury risk and prevention strategies in amateur women's soccer,"* and outlines the aims and objective of the whole project. The plans and aims for the following chapters are also presented in this chapter.

1.2 Women's soccer

Soccer is the most popular game around the world, with over 270 million players in both genders participating in official matches and training sessions (Owoeye *et al.*, 2020). It is assumed that a similar number of unregistered players participate in non-official soccer games (Van Linschoten, 2015). Female participation in soccer has increased significantly over the past decade, with an estimated ~40 million women and girls worldwide participating in the game (Pedersen *et al.*, 2019). The number of women registered as players with the Union of European Football Associations (UEFA) grew from 1.27 million in 2016 to 1.365 million in 2017 (UEFA, 2018).

Women participate at all levels of practice, from recreational to elite (Wilson *et al.*, 2012; Blokland *et al.*, 2017). The growing participation of women in soccer has been influenced by a recent increase in social acceptance of gender equity, and the increasing interest in female soccer (Ruiz-Esteban *et al.*, 2020). In addition, the development of gender equity policies in sport (Hanlon *et al.*, 2019) and the increased financial support now available to clubs with female teams, by some governments, is helping to facilitate and promote participation (Hanlon *et al.*, 2019). Despite the increased participation of women in soccer, fewer studies have focused on female than male players.

1.3 Amateur soccer

The increase in physical inactivity is of global concern, because of its association with various major health conditions such as type 2 diabetes and cardiovascular disease (WHO, 2009). A recent systematic review reported that soccer practice may help to control and prevent type 2 diabetes and the associated risk of cardiovascular problems (Barbosa *et al.*, 2021). Therefore, it is important that sports organisations encourage participation in structured sports for all citizens (Bauman *et al.*, 2012) as a means of increasing levels of physical activity (Casey *et al.*, 2012).

Amateur soccer is an organised sport that has experienced an increase in participation of players in both genders (Van Linschoten, 2015). Fun, fitness (Piermattéo *et al.*, 2020), and sometimes competition are the main goals of players participating in amateur soccer. Amateur soccer has been shown to facilitate a players' general health and improve their personal and social skills (Nowak, 2014; Owoeye *et al.*, 2017). Developing and supporting amateur soccer among both genders can increase people's physical activity and improve their well-being (Rowe *et al.*, 2013).

1.4 The demands of soccer

Soccer is a team game that involves competitions organised by leagues, but it is also a game that some people play for leisure and fitness purposes (Owoeye *et al.*, 2020). Soccer players are subjected to physical, physiological (Saeidi, 2016), and cognitive (Giuriato and Lovecchio, 2018) demands. The physical demands of the game include short-duration sprints, high-intensity running, changes of direction, jumps, duals, tackles, and backward walking, each of which requires a certain level of physical development and coordination (Caine *et al*., 2008; Nilstad, 2014; Saeidi, 2016). Participation in soccer influences a player's physiological functions, such as maximal heart rate and oxygen consumption. These functions may reach their maximal levels, especially during competitive matches (Krustrup *et al.*, 2005). Perceptual and fast decision-making skills, and environmental awareness, are cognitive skills required for effective soccer performance (Scharfen and Memmert, 2019).

Several factors moderate the impact of the demands of soccer on a player, such as the player's physical capacity, the playing position, the level of competition, playing style, the time and importance of the game, and factors related to the playing environment (Bangsbo, 2014; Martínez-Lagunas *et al.*, 2014). To withstand these demands, a player requires adequate physical, physiological and cognitive capacities (Fuller *et al.*, 2012). Failure to withstand these demands may increase the risk of injury among soccer players (Fuller *et al.*, 2012).

1.5 Findings from studies of male players cannot be generalised to female players

There are differences in anthropometric, physiological characteristics (Pedersen *et al.*, 2019), and performance responses (Altavilla *et al.*, 2017) between men and women. These differences can impact the injury risk profile of the two genders. Men have been found to exhibit higher structural and mechanical characteristics, giving them faster speed, and greater strength and performance in gross functions, such as ball headings, compared with women (Pedersen *et al.*, 2019). Larruskain *et al*. (2017) reported differences in biomechanics and neuromuscular control of the trunk, hip and knee, to result in different injury patterns and locations between men and women. The resulting time loss due to injury was longer in women than in men because women sustained a higher incidence of severe injuries to the joints and ligaments (especially the anterior

cruciate ligament (ACL)) than men. Women were also reported to play slower and to cover shorter total distances than men due to their lower physical and physiologic characteristics (Altavilla *et al.*, 2017). In contrast, men have a greater ability to develop muscle mass through training due to higher testosterone production, which increases their muscle strength and aerobic capacity (Altavilla *et al.*, 2017). Higher muscle strength decreases the probability of injuries among soccer players (Croisier *et al.*, 2008). Additionally, men have been found to have greater joint flexibility in the upper body (shoulders and trunk), while women have greater flexibility in the lower limbs, particularly in abduction. Female athletes also have a greater dynamic balance compared with their male peers (Altavilla *et al.*, 2017). These differences support the assertion that findings from studies of male players cannot be wholly generalised to female players (Sentsomedi and Puckree, 2016; Pedersen *et al.*, 2019), highlighting the need for separate research on injury risk profile among female players.

1.6 Injury profile among amateur women soccer players

A systematic review of soccer injury epidemiology revealed that amateur women soccer players sustained higher injuries per 1000 hours of soccer exposure (0.7–20.3) than elite women (3.19–8.40) and amateur men (0.6–12.4) soccer players (Klein *et al.*, 2018). Few studies have explored injury profiles (i.e., incidence and characteristics) among amateur female players. However, studies that have been conducted reveal wide methodological disparities (i.e., injury recording methods, characteristics of players, length of soccer season, and severity of recorded injuries).

A study among Caribbean amateur women soccer players (from Trinidad and Tobago) reported a high incidence of 27.6 injuries per 1000 hours of soccer exposure during a four-month league (Babwah, 2014). While most injuries were described as non-contact and of mild severity, a higher number of injuries did affect the area from the knee and below (knee, ankle, leg and foot) compared with other areas of the body (Babwah, 2014). No detailed incidence of injury for each anatomical location was provided in that study. In addition, because of a lack of elite players in Trinidad and Tobago, the amateur players (receiving no incentives for playing) also competed in the premier league. Accordingly, findings from this study are not representative of the true amateur level.

A study among amateur women playing soccer at the top-level league in Luxembourg reported an injury incidence of 0.7 injuries per 1000 hours of exposure, with the knee to be the most affected location, and with a higher proportion of injuries at the capsules and ligaments (Lion *et al.*, 2014). This study was completed during a full season; however, no comprehensive investigation of all injuries was provided because it considered only moderate to severe injuries (those which result in more than 15 days absence from soccer), possibly explaining the relatively low incidence of injuries.

A British study among amateur women soccer players reported an overall incidence of match injuries to 21.79 injuries per 1000 playing hours (Fuller *et al*., 2007). Most injuries affected the lower limbs, were of moderate-severity, resulted from player-to-player contact, and affected the ligaments and cartilage. This study only provided injury data from during matches and included no information on training sessions.

A retrospective study among Spanish amateur women soccer players recorded injuries from the medical practitioners of the Spanish Football Federation and reported most injuries affecting the joints and ligaments were at the knee, contact injuries were higher during matches, and most non-contact injuries were severe (Del Coso *et al.*, 2016). This study considered injuries that required medical attention and omitted self-managed injuries, even if they led to absence from soccer practice. The methodology used (recording injuries by medical staff of the national Football Federation in Spain) may not be feasible in similar studies among amateur players from other countries.

In summary, the aforementioned studies reveal that the knee is the most-affected location, and that the ligaments are the most-affected structures among amateur women soccer players. However, a synthesis of the findings regarding the incidence and severity of injury is not possible because of differences in the players' levels, length of the season, the severity of the included injuries, and the definitions of injury used. Hence, a need exists for a detailed exploration of the injury profile among female soccer players who play only at the amateur level and considering soccer injuries that restrict soccer practice even if they require no medical attention. Comprehensive information regarding injuries is essential to inform future injury prevention research and interventions among amateur women soccer players.

1.7 Consequences of soccer injuries

Soccer injuries and the resultant player's absence from games and practice sessions have been found to negatively impact a player, as well as the team and leagues (competitive games) (Faude *et al.*, 2006) at all playing levels. Soccer injuries can affect a player's health and well-being (Moreira *et al.*, 2014). The physical impact of soccer injuries can lead to short-term consequences such as pain, tissue swelling, and restriction of movement (Rosen, 2017). The long-term consequences of soccer injuries can include chronic pain syndrome (Rosen, 2017) and a higher chance of future osteoarthritis among effected players (Kristiansen and Larsson, 2017). Osteoarthritis is five to twelve times more common among soccer players compared with non-sporting people, due to the low healing capacity of the cartilage and soft tissues around the knee after ligament injuries (Lee and Chu, 2012). Furthermore, concussion injuries can result in several negative consequences, such as depression, fatigue, anger, and confusion (Turner *et al.*, 2017). The long-term consequences of concussion include decreased neuromuscular control, which can increase the chance of further injury (Sugimoto *et al.*, 2018), changes in cognitive function, neurodegenerative disorders, and disturbance in the cerebral blood flow (Vedung, 2021).

The negative psychological impact of injury on the soccer player can affect the team's performance (Hägglund *et al.*, 2013a). Examples of this impact include negative mood, depression (Clement *et al.*, 2015), anxiety (Tripp *et al.*, 2011), and kinesiophobia "*fear of movement*" (Flanigan *et al.*, 2013, p.1323). This fear of movement originates from the player's connection between particular movements and the possibility of re-injury (Flanigan *et al.*, 2013). Furthermore, higher levels of kinesiophobia after ACL reconstruction can influence successful return to sport (Hsu *et al.*, 2017). Soccer injuries can also result in a player's withdrawal from their team (Sadigursky *et al.*, 2017), which can affect the team's overall performance and decrease their chance of success because of a lack of qualified substitute players (Hägglund *et al.*, 2013a).

Soccer injuries may result in adverse economic impacts on the players and their teams. Unalike their elite peers, free health services and access to high-quality health services are not provided for amateur players (Franjić, 2019). Therefore, rehabilitation forms a huge financial burden for these players. In amateur soccer, the average cost per injury is reported to reach €4030 among

Swedish women players ≥ 30 years of age (Gebert *et al.*, 2018). The lower health support for injured players and the associated economic cost of injury may increase the risk of stress and anxiety among injured amateur players (Giritlioğlu and Erzeybek, 2020).

Hence, despite the health-promoting benefits of soccer practice (Owoeye *et al.*, 2020), soccer-related injuries can cause numerous short- and long-term negative impacts on players and their teams. Therefore, injury prevention must be encouraged among soccer players at all levels to reduce the risk of these injuries.

1.8 Risk factors for soccer injuries

Risk factors in sport vary according to the nature of the game, its rules, and the playing environment (Fuller *et al.*, 2012). Unalike hockey, volleyball, basketball and handball, which state different rules for men and women (e.g., ball size), soccer rules are the same for both genders playing at the same level (Pedersen *et al.*, 2019).

Soccer rules and regulations were originally designed for, and are thus suited to, male players and their abilities. This can place female players at higher risk of soccer injury compared with their male peers because of physical and physiological differences between genders (Pedersen *et al.*, 2019).

Risk factors for soccer injuries are usually categorised as intrinsic, being related to the player's characteristics or behaviours (such as age and soccer skills level), or extrinsic, being unrelated to the player's characteristics or behaviours (such as the playing environment (e.g., playing surface) and nature of the game (e.g., collisions between players)) (Hopkins *et al.*, 2007). Because some risk factors can be modified to prevent injuries, risk factors can be also classified into modifiable (such as muscle strength) and non-modifiable (such as gender) (Bahr and Krosshaug, 2005).

Modifiable risk factors are targeted by injury prevention interventions such as training and behavioural changes (Bahr and Krosshaug, 2005). Modifiable risk factors can be intrinsic, such as fitness level, or extrinsic, such as the playing surface. Similarly, nonmodifiable factors can be intrinsic, such as age and previous injury, or extrinsic, such as playing position (Theisen *et al.*, 2014). Identification of intrinsic risk factors is easier than identification of extrinsic ones, which

often renders the former the focus of sports injury research (Theisen *et al.,* 2014). However, extrinsic factors such as exposure and climate change (Waldén *et al.,* 2013) can significantly affect the risk of soccer injuries.

The biopsychosocial model supports the effect of both intrinsic and extrinsic risk factors on the risk of injuries. This model suggests that to understand a person's medical condition (e.g., a sports injury), it is essential to consider biological, psychological, and social factors (Engel, 1980). Therefore, equal investigation of intrinsic and extrinsic risk factors for soccer injuries among women players is required.

Studies have identified some risk factors to be common to males and females, such as the presence of a previous injury (Smith *et al.,* 2012). Other risk factors may preferentially expose female soccer players to greater risk of injury as a result of gender-related differences (Pedersen *et al.,* 2019). Concussion injuries are more common in women when heading a ball (Delaney *et al.*, 2014; Chandran *et al.*, 2017) of the same size and inflation as used for men (Mooney *et al.*, 2020). This is purportedly because women have a lower capacity to bear an equal amount of force applied to the head and neck than men
(Delaney *et al.*, 2014). Further explanations are the lower head mass, neck mass, and isometric strength of the neck muscles (Mooney *et al.,* 2020), in addition to the greater head and neck peak angular accelerations among women compared with men (Caccese *et al.*, 2018). Thus, head injury prevention measures such as biomechanical and behavioural education, and strength training of the neck muscles, are highly recommended for women soccer players (Mooney *et al.*, 2020).

Gender-related differences may allow some risk factors to develop earlier in females. Higher exposure to soccer is a risk factor for soccer injury because of increased fatigue, which increases the risk of soccer injuries among both genders (Söderman *et al.,* 2001; Malone *et al.,* 2017a). However, under similar playing conditions, fatigue has been found to occur faster in women, because they generally have lower endurance, speed, and leg strength when compared with men (Pedersen *et al.,* 2019).

Some prospective studies (level 2 evidence on the Oxford Centre of Evidence-Based Medicine (OCEBM) scale) have investigated risk factors for soccer injuries among elite women soccer players. A regression analysis model has been commonly used to determine relationships

between injury and one or more potential risk factors (Damasceno, 2020). Results of such analysis are represented by the Odds Ratio (OR), a measure of association between an exposure and an outcome (Szumilas, 2010), with exposure being the risk factor and the outcome being the soccer injury. The value of OR is commonly used to quantify the risk factors in sport injury research, with larger values indicating stronger risk factors (Bahr and Holme, 2003).

A study among German elite women soccer players reported the risk of ACL injury to be five times higher (OR = 5.24, CI 95% 1.42–19.59, p = 0.01) among players who had sustained a previous ACL injury (Faude *et al.*, 2006). A similar Swedish study identified general joint laxity (OR = 5.3, CI 95% 2.0–13.5, p < 0.001), and a player's age being over 25 years (OR = 3.7, CI 95% 1.7–10.5, p < 0.01) to be risk factors for injury (Roos and Östenberg, 2016). Based on the OR values in the aforementioned studies (Faude, 2006; Roos and Östenberg, 2016), general joint hypermobility is the strongest risk factor, followed by previous injury, and the player's age being over 25 years. However, prospective studies investigating the risk factors for injury in women's soccer are sparse
(Sentsomedi and Puckree, 2016). Moreover, synthesis of the findings from these studies (including the identification of the factors associated with higher risk of injuries) is required to inform prevention programmes tailored for soccer playing women.

Synthesising the evidence regarding risk factors in a systematic review would provide quick access to an evidence-based reference on soccer injury for specialists in the field (Ganeshkumar and Gopalakrishnan, 2013). Systematic reviews help to decrease the time required to find the evidence, and they improve generalisation and increase the accuracy of findings (Petticrew and Kennedy, 1997).

Two systematic reviews have synthesised risk factors associated with sport injuries among adult male and female athletes (Smith *et al.*, 2012; Murphy, 2015). While these two reviews have identified several internal and external risk factors, such as previous injury, and increased athletic exposure, neither provided any specific results for women soccer players. Accordingly, generalisations that can be made based on their findings are limited. In addition, Smith *et al*. (2012) included case-control studies in which an investigation was conducted after the occurrence of injury, which may not be the best method for identifying risk factors for soccer

injuries due to the inability to control exposure and the possible risk of recall bias (Sedgwick, 2014a).

One systematic review conducted to identify risk factors for soccer injuries among elite youth players (between 6 and 19 years of age) from both genders (Burr, 2015) identified higher exposure, previous injury, and higher soccer skills to be risk factors. However, the generalisation of these findings to women is limited because of age differences (Atan and Kassim, 2019), in that the youth participants in Burr (2015) were physically maturing, at a stage characterised by rapid physical (body size, shape, and composition) hormonal and physiological (neuromuscular control and coordination) changes that could affect the possibility of injury (Mandorino *et al.*, 2022). A further systematic review of elite men soccer players (McCall *et al.*, 2014) examined scientific evidence for the top three risk factors, and identified evidence to be highest for previous injury, lowest for fatigue, and inconclusive for muscle imbalance.

Gender differences limit the extent to which generalisations of these findings can be made to women players (Pedersen *et al.*, 2019). Hence, there the need exists for dedicated study of risk factors for injury in female players.

McCall *et al.* (2014) included both prospective and retrospective studies. In a prospective study, an outcome has yet to occur when a study is commenced, and participants are monitored over time. Conversely, in retrospective studies, an outcome is already known, and research entails exploring historical information, either from participants or from their medical records (Talari and Goyal, 2020). While retrospective studies cannot identify the risk factors because of a lack of data on accurate exposure and control of confounders, they can provide information on the prevalence of a risk factor among a cohort (Talari and Goyal, 2020). Accurate exposure to the risk factor and control of confounders are possible in prospective studies, and the potential bias is lower in these studies compared to retrospective/cross-sectional studies (cross-sectional studies analyse data collected from a population for a given point in time (Wang and Cheng, 2020)). While these advantages make prospective studies preferrable for identification of risk factors, such studies also require longer time and are more expensive to conduct than retrospective/cross-sectional studies (Sedgwick, 2014b).

No known review has synthesised the existing evidence regarding potential risk factors in women's soccer from only prospective studies. Furthermore, no review has synthesised the

existing evidence regarding the modifiable and non-modifiable risk factors in the cohort of adult women soccer players. Evidence identifying the modifiable risk factors which can be targeted by injury prevention interventions is essential to inform future research aimed at reducing the risk of injuries among women soccer players.

1.8.1 Female-related risk factors

Various anatomical, physiological, and hormonal differences exist between males and females (Pedersen *et al*., 2019) that contribute to disparities in functional and physical abilities between genders (Porras *et al.*, 2020). The female body undergoes several hormonal changes during maturation, the menstrual cycle, pregnancy (Białka *et al.*, 2017), and when using contraceptives (Porras *et al.*, 2020). These changes involve alterations in the blood levels of female sex hormones such as oestrogen and progesterone (Martin *et al.*, 2021).

Normal menstruation lasts for 28 days and is divided into the two main parts of follicular and luteal phases. During the follicular phase, oestrogen levels increase and reach their peak before the day of ovulation. At the end of this phase, the level of the luteinizing hormone increases and reaches its peak on the day of ovulation. The levels of these hormones then decrease gradually. In the luteal phase (which lasts for 14 days), the levels of progesterone in the blood increase. If implantation of the fertilised egg fails during this phase, the progesterone levels decrease and result in menstruation (Białka *et al.*, 2017). These hormonal fluctuations can alter the structure and function of musculoskeletal tissues (e.g., muscles, ligaments, and tendons) (Chidi-Ogbolu and Baar, 2019).

A study of trained adult women (18–37 years of age) found lower recovery of muscle strength among participants with higher oestrogen levels (Markofoski and Braun, 2014). The authors hypothesised that the oestrogen may reduce the changes (i.e., increase or decrease) in the muscle strength. While poor recovery is an established factor of sport injuries (Kellmann *et al.*, 2018), its association with the menstrual cycle is in need of further research. An English study conducted over a four-year period found that muscle and tendon injuries were almost doubled among women football players during their early follicular phase (Martin *et al.*, 2021).

Higher levels of oestrogen increase the collagen content (i.e., elasticity) of connective tissues (Chidi-Ogbolu and Baar, 2019). Two studies have identified higher ACL injuries among female

athletes with higher oestrogen levels during the late-ovulatory phase of the menstrual cycle (Wojtys *et al*., 2000; Beynnon *et al.*, 2005). Findings of these two studies could be due to increased ligamentous laxity (Chidi-Ogbolu and Baar, 2019). Another study reported higher ACL injury incidence during the late-luteal phase (Slauterbeck *et al.*, 2002). These conflicting accounts may be due to difficulties in determining the exact days of the menstrual phase (Martin *et al.*, 2021). These studies provided no specific results for women soccer players and concentrated on ACL injuries. Therefore, further research among amateur women soccer players that includes all types of injuries, and changes in female hormones (e.g., age of first period, menstrual dysfunction, and contraceptive use) is required.

Menstrual dysfunctions include menstrual irregularity (less than 9 or more than 13 periods per year), late menarche (period starts at or after the age of 15 years) (Sundgot-Borgen and Torstveit, 2017), extended menstruation, and dysmenorrhea (pain on menses) (Martin *et al.*, 2021). Menstrual dysfunctions, energy deficiency and low bone density are symptoms of what was initially referred to as the female athlete triad, now known as the Relative Energy Deficiency (RED-S), which is a known cause of reduced athletic performance and injuries (Martin *et al.*, 2021). A study among high school athletes identified participants who reported menstrual irregularity to have an almost three times greater risk of sustaining injuries (OR = 2.7, 95% CI, p = 0.8), and had a higher incidence of severe injuries (Thein-Nissenbaum *et al.*, 2012), but no specific results were provided for soccer players. Also, generalising these findings to women soccer players is limited by age difference because most of these athletes were still physically maturing (Mandorino *et al.*, 2022). Differences in menstrual dysfunctions between injured and uninjured amateur women soccer players should be investigated further.

1.9 Prevention of soccer injuries

A comprehensive understanding of injury aetiology and developing effective prevention strategies may reduce and better control soccer-related injuries (Verhagen *et al.*, 2010). Prevention strategies usually target modifiable risk factors such as muscle strength and amount of exposure (Theisen *et al.*, 2014). In recognition of the importance of soccer injury prevention, the Fédération Internationale de Football Association (FIFA) Medical Assessment and Research Centre created a formal risk management framework, which allows soccer organisations to detect, categorise and examine potential risks using a logical and clear procedure (Fuller *et al.*,

2012). It is important to understand that the main aim of risk-management protocols is not to eliminate the risk factor's effect, but to control these factors and improve awareness of players and all staff involved of the remaining risk (Fuller *et al.*, 2012). For example, fatigue is an established risk factor of soccer injuries (Soligard *et al.*, 2016). Risk-management programs do not aim to eliminate fatigue because this is not possible. Instead, these programmes aim to delay the onset of fatigue and ensure adequate recovery from fatigue before the next game. The stakeholders (i.e., players and their coaches) should be aware that fatigue will happen, however, they can delay its onset and intensity through appropriate prevention strategies such as warm up and hydration. The FIFA risk-management framework is for men, women and children, with no special risk-management instructions for any specific group of players.

At the 131st annual general meeting of The International Football Association Board held in London on 3 March 2017, the board gave national Football Associations the option to modify some laws of the game for amateur and youth football to reduce the risk of injuries among players of both genders in their own countries. These areas included reducing the size of the pitch, the size of the goal, and the duration of the two halves of the match, in addition to playing with a smaller and/or a lighter ball compared with that used at elite level (IFAB, 2018). Reducing the size of the pitch, the goal and the duration of the two halves may help to reduce the risk of fatigue among players at amateur level, as they have less strength and conditioning training, and have lower physical and physiological characteristics compared with their elite peers (Lorenz *et al.*, 2013). In addition, reducing the size of the ball may reduce the risk of concussion during soccer headings among amateur soccer players, whose neck muscle strength is lower than that of elite players (Lorenz *et al.*, 2013). These modifications of the laws are based on differences in playing level and age, but not gender. There is no information on whether implementing these new rules among amateur women teams has had any benefit.

FIFA encourages the implementation of injury-prevention practices to decrease the incidence of injuries, as well as to reduce the resulting time loss among soccer players (Junge *et al.*, 2011; Bisciotti *et al.*, 2019). Soccer injuries can be reduced by implementing several strategies or measures that help to improve the players' tolerance of soccer demands (Talpey and Siesmaa, 2017). For instance, an adequate warm-up can reduce the risk of muscle fatigue and increase muscle elasticity (Soligard *et al.*, 2009). Adequate warm-up also increases the blood circulation within the muscles, leading to higher muscle viscosity, higher oxygen supply, delayed

accumulation of waste products, and faster contractions (Woods *et al.*, 2007). An adequate cool-down period serves to remove the waste products resulting from prolonged physical activity, in addition to reducing the risk of muscle injuries and post-exercise cardiovascular problems (Van Hooren and Peake, 2018).

A healthy diet (Gravina *et al.*, 2012), hydration (Aragón-Vargas *et al.*, 2009), and adequate sleep (Silva *et al.*, 2020) are all required to avoid fatigue, and to reduce concentration and attention deficits. In addition, several exercise programmes based on randomised controlled trials have been applied to decrease injury among soccer players from both genders, such as the 'Prevent Injury and Enhance Performance (PEP)' programme, and the 'Knee Injury Prevention Programme' (KIPP) (Voskanian, 2013).

After one year of PEP intervention, involving exercise and education on safe landing techniques, PEP resulted in an 88% reduction of contact and non-contact ACL injuries ($p = 0.0003$) among female soccer players (Mandelbaum *et al.*, 2005). KIPP resulted in a 65% reduction in non-contact lower limb injuries ($p = 0.04$) among female soccer and basketball players (LaBella, 2012). These prevention programmes are neuromuscular training programmes aimed at reducing the risk of injuries around the knee joint, such as ACL (Voskanian, 2013).

A more comprehensive programme introduced by the FIFA Medical Assessment and Research Centre, the FIFA 11+ programme (Bizzini *et al*., 2013), includes a warm-up session, and a total of 15 exercises. This programme comprises three basic exercise sessions: a running and active stretching session, a high-speed planting and cutting exercise, and finishing off with core and leg strength exercises. These exercises concentrate on strengthening the core and leg muscles to improve static, dynamic, and reactive neuromuscular control, coordination, balance, and agility (Bizzini and Dvorak, 2015). A systematic review and meta-analysis (no exclusion based on age or gender) revealed that application of FIFA 11+ reduced the overall risk of soccer injuries by 35%, $p < 0.001$ (Al Attar *et al.*, 2018).

To increase the effectiveness of injury-prevention programmes, they are included in the four-step model of Van Mechelen *et al*. (1992). This model includes identification of the incidence of soccer injuries and severity of injury, identification of the aetiology and mechanism of injury, introduction of prevention measures, and finally, assessment of their effectiveness by repeating the first step (Van Mechelen *et al.*, 1992). However, these programmes (i.e., KIPP, PEP, and

FIFA 11+) are biomechanical, in that they focus only on motor impairments (Van Tiggelen *et al.*, 2008). A missing component of this four-step model of injury prevention is that it does not take psychosocial factors, such as the attitude, behaviour, and motivation of the players into consideration. In addition, it is not considering the implementation of prevention methods to increase their effectiveness (Van Tiggelen *et al.*, 2008).

In 2006, this four-step model was expanded through the Translation of Research into Injury Prevention Practice (TRIPP) model (Finch, 2006) to include detailed information on how these prevention programmes are implemented in real life (Finch, 2006). The expanded model now included six stages, and has been widely used in recent sport injury prevention research (Ross *et al*., 2021). The aims and advantages of each stage of the expanded model, and any published research using them on amateur women soccer players (to the author's knowledge) are presented in Table 1-1. Recently, injury prevention studies have followed this model and examined implementation (Al Attar *et al.*, 2018) and adherence to the prevention programme among elite and amateur players (Silvers-Granelli *et al.*, 2019; Gebert *et al.*, 2019).

While one study has investigated the perception of players regarding risk factors and prevention strategies (Zech and Wellmann, 2017), an issue with it is that it was conducted with male players, and so results from it cannot be directly applied to female players because of differences in physiological and anthropometric characteristics (Pedersen *et al.*, 2019).

Only McKay *et al.* (2014) explored the implementation of an injury prevention programme (FIFA11+) among a female population, and it involved only elite youth soccer players. Several barriers for the low players' adherence to FIFA11+ were identified, such as a gap in the players' and coaches' knowledge about this program. Extrapolating findings from this study to women in general is also limited by age differences (Atan and Kassim, 2019).

The correct implementation of these injury prevention programmes (Finch, 2006) is required to decrease injury incidence and limit their negative impact on women soccer players and their teams. However, studies investigating injury prevention behaviour among women soccer players are few, and none concerns amateur women. Therefore, studies investigating injury prevention behaviour and the barriers and facilitators of that behaviour among amateur soccer-playing women are required to inform tailored risk management and injury prevention interventions among this cohort.

Table 1-1 The six stages of Translation of Research into Injury Prevention Practice (TRIPP) model

Stage	Aims	Advantages	Published literature among amateur women soccer players
One	Injury surveillance using valid and reliable methodologies and standardised injury definitions	Informing all other stages Help to measure the burden of sport injuries and the associated risk	Present but rare (Del Coso *et al.*, 2016).
Two	Understand the aetiology and mechanism Using valid and reliable methodologies and prospective study design	Inform prevention research and intervention, identify modifiable and nonmodifiable factors	Absent
Three	Identifying potential solutions and prevention measures appropriate for the previously identified factors, using multidisciplinary approaches	Manage and reduce the effect of risk factors	Absent
Four	Assessing the effectiveness of intervention measures at ideal conditions	Increase the evidence base about the efficacy of intervention measures	Absent
Five	Understand how the prevention measures can be translated into real life practice Identify risk perception among stakeholders	Identify barriers/facilitators, guide the behaviour modification if required	Absent
Six	Implementing prevention measures in real world and evaluate their effectiveness	Determine the effectiveness of prevention measures in real life world	Absent

1.10 Determinants of players' preventive behaviours

Human behaviour is determined by multiple factors. Of these, some are related to the subject, such as own beliefs, and physical abilities, and others are related to the environment, such as the impact of the community and the socio-cultural aspects (Duminica, 2020). These factors could increase (facilitators) or decrease (barriers) the players' implementation of injury prevention programmes. According to the TRIPP model, factors affecting the player's preventive behaviour must be identified to increase their adherence to injury prevention programmes and decrease injuries (Finch, 2006). Managing these factors, that is, providing the facilitators and removing the barriers, is required to enhance players' adherence to injury prevention programmes

(McClure *et al.*, 2010). However, there is a lack of research exploring the barriers and facilitators to implementing injury prevention programmes among amateur women soccer players.

Several socio-cultural models have been used in sports injury prevention research to explain the interaction of these factors, such as the biopsychosocial model (Engel, 1980). Another useful model, the socio-ecological model, considers the factors contributing to injuries in the individuals, their organisation, and the community (Bogardus *et al.*, 2019). Understanding these models can help specialists in sports injury prevention to predict the player's uptake of injury prevention measures, which results from the interaction between the internal and external factors pertaining to that player. Also, these models can inform the planning of sports injury prevention by modifying, controlling, or encouraging the player's adaptation to these factors (Wiese-Bjornstal, 2010).

Health behaviour theories can guide sports injury prevention specialists to understand the causes of inadequate implementation of the prescribed intervention measures (poor adherence) among players (Hartley, 2018). Examples of these theories include the health belief model (Hartley, 2018), which suggests that one's belief in personal susceptibility to disease or injury and belief in the effectiveness of a suggested preventive behaviour will predict the uptake of that behaviour (Hartley, 2018); self-determination theory, which indicates that the fulfilment of the peoples' needs for competence, connection and independence will make them self-determined (Chan and Hagger, 2012); and the theory of planned behaviour (TPB), which suggests that behavioural intentions and perceived behavioural control determine one's behaviour (Hartley, 2018). These health-behaviour theories can help to improve players' adherence to injury prevention measures through behavioural modifications (Munro *et al.*, 2007).

The TPB has been frequently used in sport injury prevention intervention and research (McGlashan and Finch, 2010) such as skaters (Deroche *et al.*, 2009), basketball (Iversen and Friden, 2009) and football players (Finch *et al.*, 2002). The TPB states that the main determinant of behaviour is the individual's intention for action (Ajzen, 1991). The individuals' intentions are influenced by their opinions towards the behaviours, perceived behavioural controls, and subjective norms (Hardeman *et al.*, 2001). The TPB also, states that the individuals' knowledge about a specific issue could predict their intentions and behaviour towards that issue (Ajzen *et al.*, 2011).

Players' knowledge regarding injury risk and prevention is an essential factor that promotes programme adherence (White *et al*., 2014). A questionnaire-based study conducted to identify the effect of coach and player knowledge, attitudes, and beliefs on adherence to the FIFA 11+ programme among female youth soccer players (McKay *et al*., 2014) reported that the lack of players' knowledge of the FIFA 11+ programme was one of the main obstacles to their adherence to that programme (McKay *et al*., 2014). The study was conducted with female youth players, and so the differences in the functional skills and behavioural characteristics between adult and youth soccer players (Figueiredo *et al.*, 2020) restricts extrapolating all of its findings to women in general. Also, the findings from that study cannot be generalised to women teams from other countries because of regional differences such as climate and playing style differences (Waldén *et al.*, 2013).

Exploring the players' level of knowledge about injury risk and prevention, and how that knowledge affects their preventive behaviour, is essential to determine appropriate interventions (e.g., modification of knowledge or provision of facilitators) to modify player behaviour and increase their adherence to injury prevention programmes. Changes in beliefs brought about by improving knowledge may lead to behavioural change, yet this is not enough. Behavioural change approaches such as self-management methods are required to encourage change (Hardeman *et al.*, 2001). The main concept of self-management programmes is to provide the individuals with the required tools (the knowledge, skills, and expertise) to help them change their behaviour and take a greater role in reducing the chance of their injuries (Smalley *et al*., 2019). Identifying and addressing the barriers and facilitators of the players' preventive behaviour are equally important to facilitate preventive behaviours (Finch, 2006).

Chapters 3 and 4 will explore players' level of knowledge of soccer injury risk and prevention and the preventive behaviour of amateur women soccer players. Chapter 4 will present a clearer understanding of the players' preventive behaviours and identify the barriers and facilitators of amateur women soccer players' behaviour in preventing soccer injuries.

1.11 Impact of regional differences on soccer injuries

An important issue to consider when exploring injuries, or planning injury prevention programmes, is the difference between regions or localities, which may impact soccer injuries

(Eirale *et al.*, 2017). For instance, women soccer players from northern Sweden were found to sustain higher match injuries compared with their southern peers, because of the higher training and match exposure in the north (Jacobson and Tegner, 2007). Also, male soccer players from northern European countries experience higher incidences of severe and overuse injuries during matches compared with players from southern European countries near the Mediterranean Sea (Waldén *et al.*, 2013). Possibly because of regional differences in the increased speed of passes, aggressiveness, and number of collisions, which give rise to more contact injuries among players from northern Europe. Players from northern Europe were also found to play with pain and injury, which increased the chance of overuse injuries (Bahr, 2009). Finally, the hardness of the playing field can increase the ground reaction force against the lower limbs, thereby increasing the loading on tissues, and hence the risk of injury (Waldén *et al.*, 2013).

Differences in culture and religious practices can influence the incidence of soccer injuries (Eirale *et al.*, 2017). For example, the impact of Ramadan fasting on the rate of soccer injuries differs among two Muslim groups, with a Tunisian study showing a higher rate of overuse injuries among fasting soccer players (Chamari *et al.*, 2012) than a Qatar study, which found no impact of fasting on injury rates among soccer players (Eirale *et al.*, 2013).

The amount of training and physical conditioning are differences that can influence injuries at a regional level. Injuries were found to be higher among Asian teams in international competitions because of lower conditioning when compared with their European counterparts (Eirale *et al.*, 2017). Differences in the method of detection and recording of injury data can also influence the accuracy of injury reporting, as reported in a Korean study which compared the accuracy of injury reporting between national level Asian and European teams (Yoon *et al.*, 2004). European teams used the team's physician or physiotherapist's records, detecting injuries while analysing video of the game, or by retrospective self-reporting of injuries by the player. In comparison, injuries among Asian teams were recorded through a combination of these methods, in which trained independent staff detected injuries real-time during the match, and then, to assess their reliability, compared them to injuries in the medical team's report. As a result, teams from Asia exhibited a higher injury incidence compared with European teams (Yoon *et al.*, 2004).

Based on these aforementioned studies, regional differences such as climate, religious practice, culture, and playing style can influence soccer injuries. However, the impact of regional

differences on women soccer players' perceptions of risk factors has not been evaluated. Some risk factors may have a greater perceived impact than others depending on the population and the region investigated (Knutson, 2014), such as aggression as a risk factor for sports injuries (Schwebel *et al*., 2007). However, the perception and recognition of aggressive playstyle varies in different regions (cultures) (Waldén *et al*., 2013). Some cultures accept the aggressive playstyle as a kind of competition while others consider it to be an illegal behaviour (Wiese-Bjornstal, 2010). Furthermore, research on injury prevention strategies among amateur women soccer players in different regions is rare. Eirale *et al*. (2017) suggest that the same prevention programmes cannot be implemented all over the world, as cultures, habits and religious practice could influence the risk of sports injury, and players' implementation of preventive strategies. No studies have been identified that explore players' injury risk profiles, perception of injury risk factors, and preventive behaviour among amateur women soccer players across various countries. Moreover, the findings from such studies could inform cross-cultural comparative studies in the field and increase the effectiveness and appropriateness of soccer injury prevention programmes for application.

1.12 Gender, culture, and sports participation

Gender and sex are frequently used interchangeably, however, they refer to different concepts (Neculaesei *et al.*, 2015). Sex refers to the biological and physiological characteristics that distinguish males from females such as chromosomes, hormones, and reproductive organs. Gender refers to the roles created socially such as behaviours, identities, expressions, and norms that distinguish women/girls from men/boys. Gender includes the perceived role and identitfication of individuals towards themselves and others (Neculaesei *et al.*, 2015). Gender equality is an essential right for citizens in any country, yet the levels and areas of gender inequality vary around the world (Albu and Vasilica, 2017). Women still do not receive equal rights with men in several life aspects such as labour, payment, and sports participation (Albu and Vasilica, 2017). Gender differences are more apparent in sports than in other fields that frequently causes constraints in sports sittings (e.g., participation and provision of support), especially for women (Gill, 2017).

Culture represents the beliefs, norms, behaviours, and values that characterise a group of people; it is shaped by religion, environment, and level of education (Al-Shahri, 2002). Culture

influences the relationships between genders and the perceived/actual role of each gender in society (e.g., the superior power of men) (Neculaesei *et al.*, 2015). The forms and descriptions of this influence change with time and differ between societies. However, in general, women have less independence, fewer resources to use, and a more limited role in the decision-making processes in their lives, and society (Neculaesei *et al.*, 2015).

Cultural differences have a great influence on sport, exercise, performance, and players' behaviour (Gill, 2017). Additionally, culture involves power and privilege, which means that one group (e.g., men) have more power and advantage than the other (e.g., women) (Gill, 2017). Power, privilege, and number of participants in sports are higher among men compared with women all over the world (Abbasi, 2014). Several barriers to women's participation in sports have been reported, such as family commitments, culture-related beliefs, lack of appropriate facilities, lack of social support (Abbasi, 2014), hot weather, and dress code (El Ansari *et al.*, 2014). Some parents have gender-stereotyped beliefs, leading to the provision of more support to practice sport for their sons than their daughters (Fredricks and Eccles, 2005). These barriers were common in all countries (Sharara *et al.*, 2018) with varying levels. Religion (a moderator of culture) was not a barrier to physical activity, yet women's sports participation is higher in western countries when compared with Arab/Muslim countries (Kahan, 2015).

Gender stereotypes are prevalent in sports and physical activity. It was believed that it was inappropriate for women to participate in activities that included strength, endurance, or physical contact (Gill, 2017). Stereotype validation expected lower performance of girls in soccer than boys (Chalabaev *et al.*, 2009). In addition, the media has shown less interest in and coverage of female than male sports participation and achievements (Gill, 2017). These factors have contributed to a reduced appreciation of female sports in some societies, despite the growing participation rate (Sharara *et al.*, 2018). Additionally, despite the improved societal recognition of gender equality (Ruiz-Esteban *et al.*, 2020) and the significant influence of gender and culture on physical activity and sports-related behaviours (e.g., injury prevention), there is very limited literature that evaluates the relationships between culture, gender, and sport (Gill, 2017). Research into this area (i.e., the relationships between culture, gender, and sport) would provide more applicable (tailored) recommendations to improve sports practice and reduce sport injuries. Hence, exploring the influence of culture on sports-related behaviour is required.

1.13 Women's soccer in different cultures

Women's participation in sports around the world has become more prominent through their continuous efforts; however, women's participation is still under-represented compared with men (Albu and Vasilica, 2017). There is male dominance (in relation to participation and support) in sports, and particularly in soccer around the world (Matheson and Congdon-Hohman, 2014). In the Republic of Ireland, which represents a predominantly Christian Western culture (Maignant, 2014), there are approximately 6,500 females from all age groups currently registered to play women's soccer in 17 domestic leagues (Liston, 2006). According to the Women's Football Association of Ireland (Bourke, 2003), this figure represents an almost 100% increase in player numbers since 2000 (Liston, 2006). In 2017, there were 5140 Irish women players registered with UEFA (UEFA Reports, 2017). Women's Football Association of Ireland teams entered senior international competitions between 1974 and 1992, but did not participate for the next three years so as to improve the national playing base; they re-entered international competition in 1995 (Liston, 2006).

In Saudi Arabia—a Muslim Middle Eastern culture (Al-Shahri, 2002)—women's soccer started with a single football team in 2008, and the first official football tournament was announced in 2019 (Lysa, 2020). The women's game has been restricted by Saudi society (e.g., gender segregation and dress code) as a consequence of limited government support (Alruwaili, 2020). However, the game's popularity has continued to grow in Saudi Arabia, with participation of females from different age groups (supporting female health through sports practice is one aim of the Saudi Vision 2030) (Al-Shahrani, 2020). However, despite this increased participation of women in soccer from Ireland and Saudi Arabia, there is no information regarding the injury risk profile and injury prevention behaviours among women soccer players. Thus, investigations are required with these groups to inform effective injury prevention programmes among women soccer players in these two countries.

In summary, the increased participation of women in soccer has seen a concomitant increase in injuries. Soccer injuries negatively affect both players and their teams. Players' knowledge of injury prevention programmes also having an impact on their injury preventive behaviours. Not only do fewer studies evaluate amateur women than their more-elite peers, and findings from men's studies are not generalisable to women; similarly, regional differences may affect generalisation.

1.14 Thesis aim and objectives

1.14.1 Aim

To explore injury risk profile, players' opinions on the risk factors, and prevention measures for injury, as well as the real-life implementation of preventive measures and the barriers and facilitators to the uptake of prevention measures among amateur women soccer players. It is envisaged that this research will provide essential knowledge to better-inform future prevention programmes tailored for amateur women soccer players.

These aims are addressed through the following research objectives.

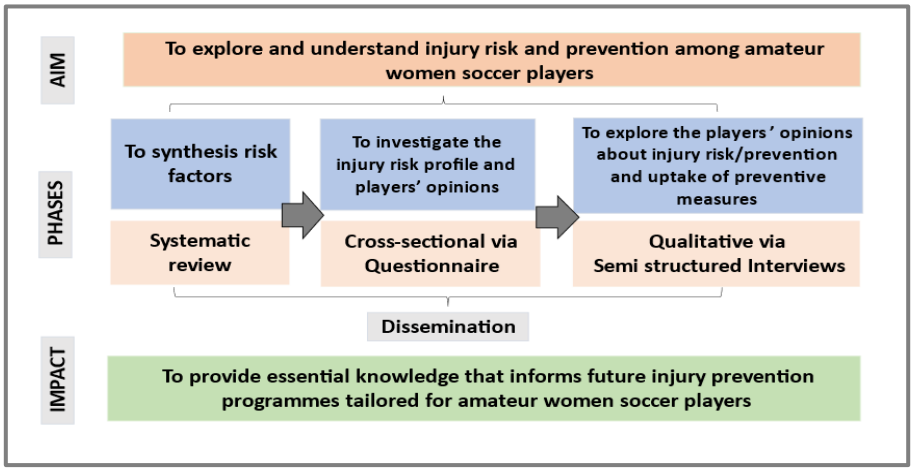
1.14.2 Objectives

1. To synthesise and collate the evidence regarding risk factors for injury in women's soccer (Chapter 2).

2. To explore the injury profile, prevalence of risk factors, and players' opinions on risk factors and injury prevention measures (Chapter 3).

3. To investigate how amateur women soccer players perceive soccer-related injury risk and prevention, including barriers and facilitators to the uptake of prevention measures (Chapter 4). Figure 1-1 depicts the research strategy.

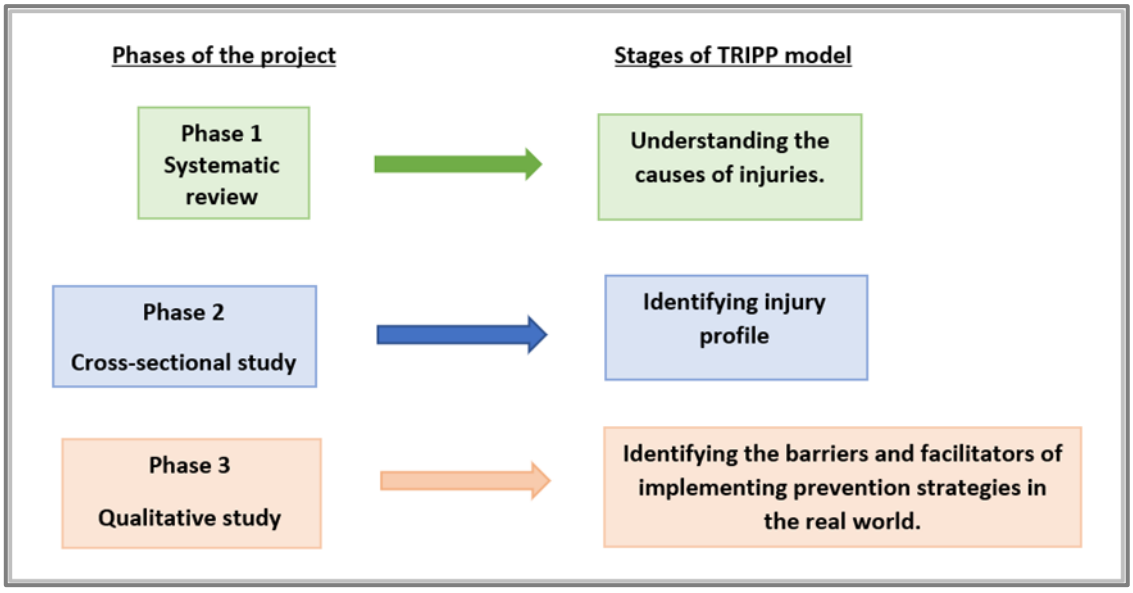
Figure 1-1 Overall strategy to address research aims and objectives



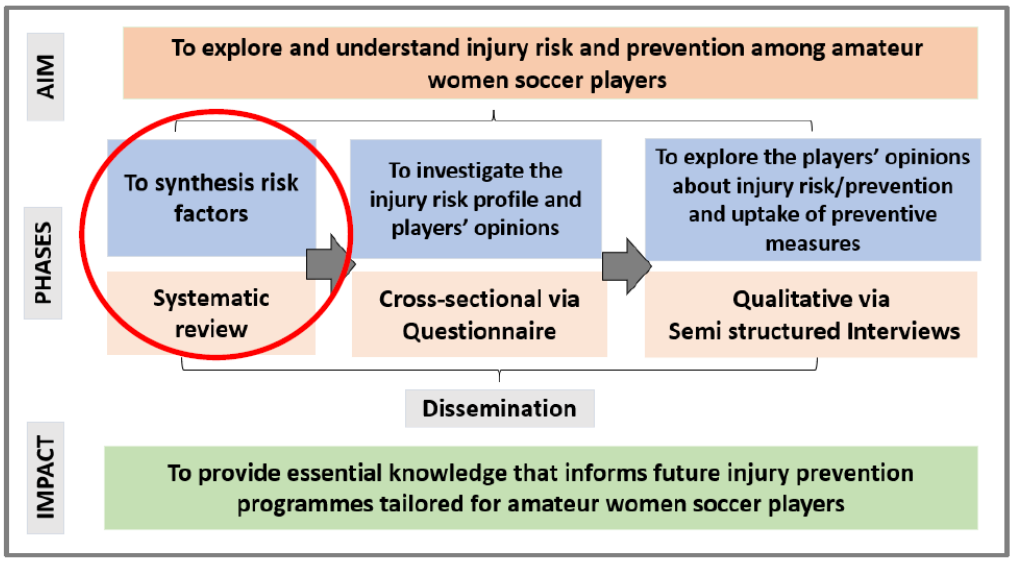
1.15 Thesis structure

This research programme consists of three interrelated phases to achieve its objectives. These three phases are built on the stages of TRIPP model and have been conducted through a systematic research programme (Figure 1-2). This chapter (Chapter 1) introduces the thesis, stating the primary research aim and objectives to achieve it. Chapter 2 presents the first research phase—a systematic review—to collate and synthesise the evidence regarding risk factors for soccer injury in women's soccer. Several intrinsic and extrinsic risk factors are identified in stage one informs the design of stage two. Chapter 3 presents a cross-sectional research study that explores the injury risk profile, and opinions on injury risk and prevention among amateur soccer players. The opinions of players identified in this cross-sectional study are further explored in Chapter 4. Chapter 4 presents a qualitative study conducted to investigate how Saudi and Irish amateur women soccer players perceive soccer-related injury risk and prevention, including the barriers and facilitators to the uptake of prevention strategies, which highlights differences between the two groups. The focus of the final chapter (Chapter 5) is a discussion of the key findings of the whole project; the expected impact of the project; the limitations of the research; recommendations for future research, and the conclusion.

Figure 1-2 Research programme phases, and corresponding TRIPP stages



Chapter 2 Systematic review



The corresponding research stage

Injuries in elite women's soccer

Alahmad TA, Kearney P, Cahalan R (2020). Injury in elite women's soccer: A systematic review. *The Physician and Sportsmedicine,* 48(3), pp. 259–265. doi:10.1080/00913847.2020.1720548

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	Research conception or design	Data collection	Data analysis and interpretation	Drafting the article	Critical revision of the article/approval for publication
Tahani Alahmad	Yes	Yes	Yes	Yes	Yes
Roisin Cahalan	Yes	Yes	Yes	No	Yes
Philip Kearney	Yes	Yes	Yes	No	Yes

2.1 Prologue

This chapter represents a comprehensive review of prospective studies, exploring the internal and external risk factors of soccer injuries among elite women. All included papers investigated the risk factors of soccer injuries among elite women soccer players. Investigating the risk factors of soccer injuries contributes to the second stage of TRIPP model (comprehensive understanding of the causes of injury). Findings from this stage can inform future prevention programmes among elite women soccer players.

Because no published prospective study explored the risk factors of soccer injuries among amateur women soccer players, this systematic review had to include studies on elite women soccer players. Because both groups (i.e., elite and amateur) are females they share the same gender-related physical, physiological, and psychological characteristics that make them different from males (Pedersen *et al.*, 2019). Also, both groups are adults (i.e., 18-or-more years of age) which eliminates the age-related differences (Cejudo *et al.*, 2019). Finally, both groups are playing soccer which make them susceptible to similar risk factors (risk factors are determined by the type of sport and its rules (Fuller *et al.*, 2012)).

Conducting a meta-analysis was not feasible because of the small number of studies, and their heterogeneity with regard to subjects, methodologies, and the risk factor investigated (Haidich, 2010).

The paper based on this chapter was published in the peer-reviewed journal *The Physician and Sportsmedicine* (Alahmad *et al.*, 2020).

2.2 Abstract

Objective: To summarise risk factors for injury in elite women's soccer.

Methods: Ten electronic databases were searched for studies that explored risk factors for injury in elite women soccer players. Study cohorts were required to consist of adult (≥ 18 years of age) elite players defined as "the best performers in their country in a certain sport who are competing at national or international levels" (Swann *et al.*, 2015). Two reviewers independently assessed articles for eligibility. The Critical Appraisal Skills Programme (CASP) checklist for cohort studies was used for quality assessment of included studies. Oxford Centre of Evidence-Based Medicine (OCEBM) guidelines were used to determine their level of evidence.

Results: Eight studies were included in this review. Findings indicated an association between an increased injury risk and previous injury and increased joint laxity. There was additional evidence to support a relationship between injuries and higher soccer exposure, playing position, increased body mass index (BMI), low hamstring to quadriceps (H/Q) ratio, player's level of balance and co-ordination, as well as various psychological issues. However, there were conflicting findings for the effect of postural control. Individual differences in Q-angle, intercondylar notch width or pelvic width measurements were not found to be associated with injury. The incidence of injury was higher in the dominant limb.

Conclusion: The risk of injury in elite female soccer players is multifactorial, complex, and associated with a range of intrinsic, and extrinsic factors. More high-quality studies are needed to investigate each identified risk factor, to inform effective injury screening.

Keywords: Soccer, football, female, women, injury risk, elite

2.3 Introduction

Participation of women in various sports has increased in recent decades at all levels of practice, from elite to recreational (Blokland *et al*., 2017). Definitions of "elite" vary, but the term has been used to describe "the best performers in their country in a certain sport who are competing at national or international levels" (Swann *et al.*, 2015). Soccer is an internationally popular sport (Faude *et al.*, 2006) that has shown a marked increase in women's participation at the elite level. The number of women registered as players with the Union of European Football Associations (UEFA) grew from 1.27 million in 2016 to 1.365 million in 2017, with the number of women playing at the professional or semiprofessional level more than doubling over a four-year period from 1680 (2013) to 3572 (2017) (UEFA, 2018).

Despite increased women's participation in elite soccer, studies investigating injury in this cohort are sparse (Sentsomedi and Puckree, 2016). Soccer is a complex, high intensity, contact sport that is associated with a considerable risk of injury (Faude *et al.*, 2006). Epidemiological studies have shown an incidence of 10–35 injuries per 1000 game hours among players in men's professional soccer, compared with 9.1–24 injuries per 1000 game hours among professional women (Giza *et al*., 2005). Although the overall incidence of injury was found to be higher in elite male soccer players than their female counterparts, the proportion of severe injuries (causing an absence of > 28 days from game or practice) appears to be significantly higher in female players (Giza *et al.*, 2005). A comparison of injuries among male and female soccer players in the same first division club identified that women reported 21% more total days lost, with 5.36 times higher rate of severe joint and ligamentous injuries, when compared with men (Larruskain *et al*., 2017). This high injury incidence had a negative impact upon the related league, clubs of the injured players, and the well-being of the players themselves (Faude *et al.*, 2006).

The risk factors for injury in soccer are complex and mediated by a host of intrinsic and extrinsic considerations (Mufty *et al*., 2015). Several of these risk factors are shared between the sexes, including trait anxiety, and negative life event stress (Ivarsson *et al.*, 2013). Exposing soccer players to large and rapid changes in athletic load also has been found to increase injury in elite soccer players of both sexes (Malone *et al.*, 2017b). Furthermore, researchers have found that newly transferred players of both sexes had a greater risk of non-contact injuries than existing players on the same team, but this risk was ameliorated by player rotation in addition to

monitoring, prevention, and recovery protocols by team staff (Carling *et al*., 2017). Certain positions, including those of goalkeeper and midfielder, have also been associated with an increased prevalence of low back pain in both sexes during a competitive season (Tunås *et al.*, 2015).

A number of factors that may preferentially expose female soccer players to injury have been identified. Differences between the sexes in the biomechanical and neuromuscular control of the trunk, hip, and knee may explain the significantly greater occurrence of quadriceps (two-fold), ankle ligament (five-fold), and ACL (five-fold) injuries in female soccer players compared with their male counterparts (Niyonsenga and Phillips, 2013; Larruskain *et al*., 2017). Furthermore, a study of elite Rwandan female soccer players identified a range of intrinsic (previous injury, age, pre-menstrual symptoms, and excessive ankle range of motion) and extrinsic factors (use of oral contraceptive pills, competition level, player position, and use of protective equipment) that were associated with injury in this cohort (Niyonsenga and Phillips, 2013). These findings suggested that different risk factors may impact upon injuries between the sexes, and that findings in studies of men may not be wholly generalisable to women.

The increase in women's participation in elite soccer, with an evident increased incidence of severe injury, warrants exploration. No review has synthesised the existing literature regarding possible intrinsic and extrinsic risk factors for injury in this cohort of elite women soccer players. This systematic review aims to summarise risk factors, to inform future research into injury screening for these athletes.

2.4 Methods

2.4.1 Literature search

A systematic search of published literature between December 1980 and August 2019 was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA) (Moher *et al*., 2009). Ten electronic databases (CINHAL, PUBMED, EMBASE, AMED, PSYCHArticles, PSYCInfo, and SPORTDiscus, COCHRANE, Sciencedirect, PEDro) were searched using a combination of the following MeSH terms and keywords: "risk" OR "risk factor" OR "cause" OR "predictor" AND "injury" AND "elite" OR "national" AND "female" OR "women" OR "woman" AND "soccer"

OR “football.” The search was first expanded by applying equivalent subjects. The search results were then refined by the publication type (reports, reviews, and single case studies were excluded), and limited to quantitative, peer reviewed studies published in English. Furthermore, the search was limited to female participants aged 18 years and older to minimise the potential impact of physical immaturity and growth-related injury in players (Caine *et al.*, 2008). Application of these search criteria identified 2137 papers. After the removal of duplicates, reprints and unrelated titles, the abstracts of articles were screened for suitability. A considerable number of citations were not relevant, as the keyword “football” also encompassed articles pertaining to American football, rugby leagues, and/or Australian football. The study population was defined as “the best performers in their country in a certain sport who are competing at national or international levels” (Swann *et al.*, 2015).

2.4.2 Inclusion and exclusion criteria:

Studies were included if they prospectively explored the association between risk factors and soccer injury (as an outcome measure). Studies that provided specific results for women players were also included. Studies were excluded if the participants were not women or elite soccer players (e.g., male participants, youth, retired players, coaches, or other team staff), or if participants were playing soccer at the university level. In the case of any ambiguity or lack of clarity, the second author (RC) screened the papers to ensure appropriateness for inclusion or exclusion. The second author also screened all resulting eight papers to confirm their eligibility.

2.4.3 Data extraction

Data on the study design, number and age of participants, participants’ affiliation, the primary aim of the study, injury definition used, risk factor investigated, methods of investigation, and findings including p value and Odds Ratio (OR) if given were extracted from the eight included studies.

2.4.4 Quality assessment

A quality assessment of the included studies was carried out using The Critical Appraisal Skills Programme (CASP) checklist for cohort studies (Akobeng, 2005) (Table 2-1). This checklist

involves 12 questions (two screening questions and ten questions evaluating the validity and reliability of the results among local populations) (Yeomans *et al.*, 2018). The CASP checklist has been used to evaluate individual prospective cohort studies investigating risk factors for injuries among athletes such as Ross *et al*. (2015) and Ryan *et al*. (2014). A high-quality study was defined as scoring positively on > 50% of the 12 items in the CASP checklist (Ijmker *et al*., 2007).

2.4.5 Assessing the weight of evidence for risk factors

Levels of evidence for the investigated risk factors were based on the guidelines of Ijmker *et al*. (2007), and were categorised as follows: strong evidence—defined as consistent findings (in > 75% of studies) in two or more high-quality studies; moderate evidence defined as consistent findings (in > 75% of studies) in one high-quality study and multiple low-quality studies; limited evidence defined as consistent findings (in > 75% of studies) in multiple low-quality studies or one high-quality study; and conflicting evidence defined as conflicting findings reported by < 75% of studies. Oxford Centre of Evidence Based Medicine guidelines were used to determine the level of evidence for the included studies (OCEBM Levels of Evidence Working Group *et al.*, 2011).

2.5 Results

2.5.1 Description of studies

Eight studies were deemed to be eligible for this review. Six of these studies involved only elite women soccer players, and two provide separate results for elite women soccer players: one involving non-elite women players (Roos and Östenberg, 2016) and the other involving elite women players in handball (Steffen *et al.*, 2017).

The present review involved 1079 elite women soccer players, of participant age within any given study ranging from 14 to 39 years. Participants in three studies were from Sweden (Söderman *et al.*, 2001; Ivarsson *et al.*, 2013; Roos and Östenberg, 2016), with further studies

from Germany (Faude, 2006), Netherlands (Blokland *et al.*, 2017), Norway (Nilstad *et al.*, 2014), and South Africa (Mohamed *et al.*, 2012). Further details are provided in Table 2-2.

2.5.2 Study quality and weight of the evidence

Of the 88 reviewed studies, eight were included (Figure 2-1). According to the criteria outlined in Table 2-2, all studies were of a high quality. According to OCEBM guidelines (OCEBM Levels of Evidence Working Group *et al.*, 2011), excepting Mohammad *et al.* (2012) which was level 3, all other studies were classified as having level 2 evidence. Table 2-3 illustrates the quality (based on the CASP checklist) and level of evidence (based on OCEBM) for all included studies. The weight of each risk factor was measured using the quality of the study, the level of evidence, and the number of studies supporting an association of that factor and the risk of soccer injury. Higher values indicate stronger risk factors.

2.5.3 Injury definition

A time-loss definition of injury was adopted by the majority of included studies (Table 2-2). However, one study defined injury as "Any injury occurs during a soccer game or practice" (Steffen *et al*., 2017). Mohamed *et al.* (2012) provided no explicit definition of injury.

Figure 2-1 PRISMA Flow Diagram

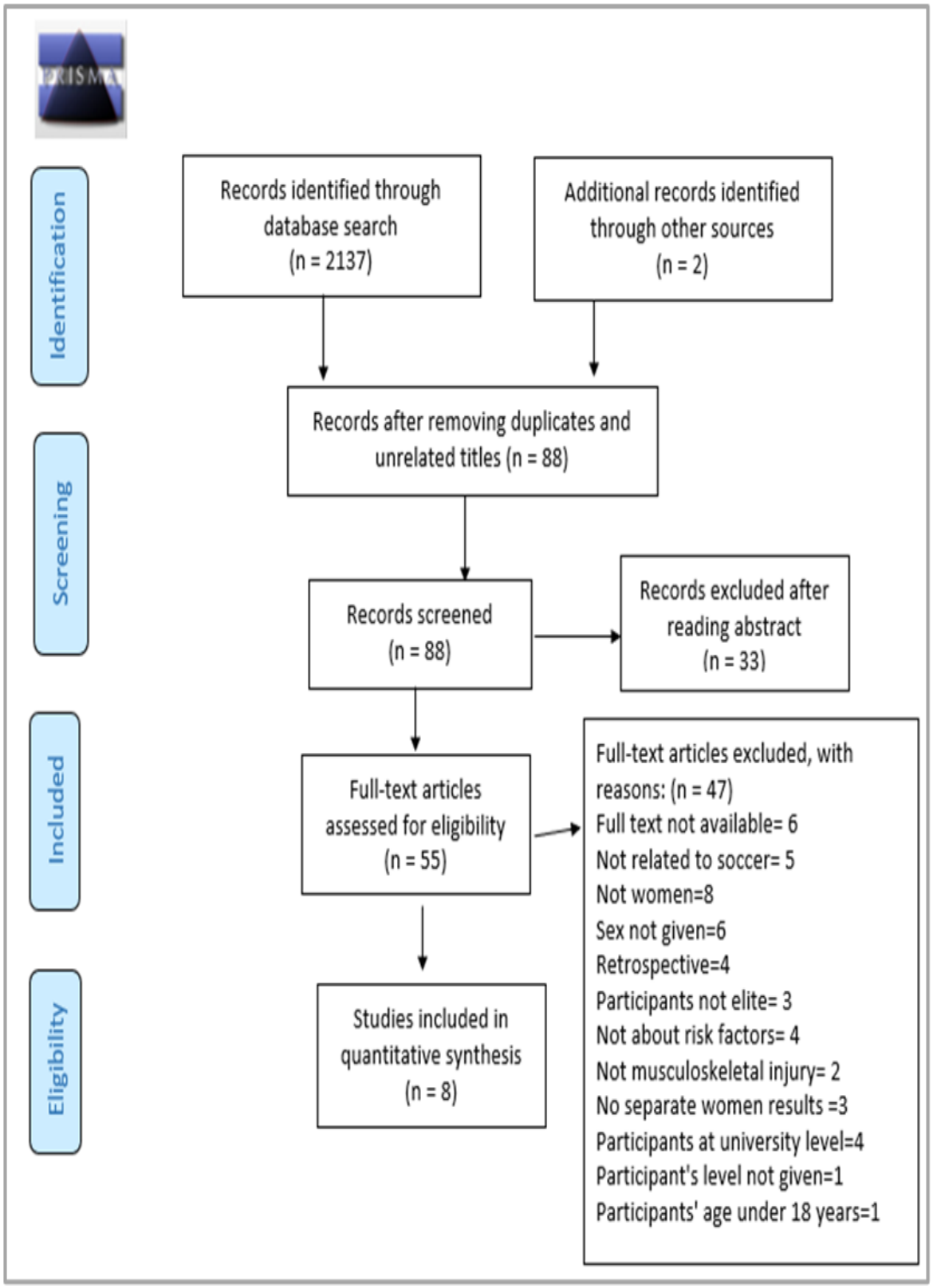


Table 2-1 CASP checklist for cohort studies

Question	Blokland *et al.* (2017)	Faude *et al.* (2006)	Ivarsson *et al.* (2013)	Mohamed *et al.* (2012)	Nilstad *et al.* (2014)	Roos and Ostenberg (2016)	Soderman *et al.* (2001)	Steffen et al. (2017)
Did the study address a clearly focused issue?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the cohort recruited in an acceptable way?	Yes	No	No	Yes	Yes	No	No	Yes
Was the exposure accurately measured to minimise bias?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the outcome accurately measured to minimise bias?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Have the authors identified all important confounding factors?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Have they taken into account the confounding factors in the design and/or analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the follow-up with subjects complete enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the follow-up with subjects long enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
What are the results of this study?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
How precise are the results?	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Do you believe the results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Can the results be applied to the local population?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Do the results of this study fit with other available evidence?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
What are the implications of this study for practice?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Overall quality	High	High	High	High	High	High	High	High

2.5.4 Risk factors for soccer injuries

Several risk factors for soccer injury among elite female players (intrinsic and extrinsic factors) are summarised in Table 2-2.

Because of the heterogeneity and small number of included studies, in addition to the limited number of studies for each risk factor, a narrative synthesis was conducted. Narrative synthesis refers to "*an approach to the systematic review and synthesis of findings from multiple studies that relies primarily on the use of words and text to summaries and explain the findings of the synthesis*" (Popay *et al.*, 2006, p.5). In this present review, the narrative synthesis was concerning the risk factor investigated, methods of investigation and the outcome measures. The levels of evidence were not applied across the studies for the various risk factors. Intrinsic factors were investigated more than extrinsic factors. There was consistent evidence for an association between an increased risk of injury among elite female players and previous injury, and joint hypermobility. Conflicting findings were reported regarding the association between injury and postural control. Finally, there was limited evidence regarding injury and soccer exposure, playing position, and several other factors (Table 2-3).

Table 2-2 Summary of study results

Publication: Country	Study design	No of participants	Age Mean ± SD or Median (IQR) years	Primary study aim	Injury definition used for pain or injury	Factors investigated	Athlete affiliation	Findings
Blokland *et al.* (2017) Netherlands	Prospective cohort study	114	22.4 ± 33.3	To investigate if general joint hypermobility is a risk factor for injury in elite female soccer players	Injury is any physical complaint sustained by a player that results from a soccer match or training, due to which a player could not fully participate in future soccer activities, including the day of injury	General joint hypermobility measured by Beighton score at baseline and injury during the August 2014 June 2015 season	Top women leagues, Netherlands & Belgium	No relationship between incidence of soccer injury and general joint hypermobility (OR = 1.49, 95% CI 0.45–4.96, p = 0.662)
Faude *et al.* (2006) Germany	Prospective cohort	143	22. 4 ± 5.0	To describe risk factors for injuries in elite female soccer players	Injury is any physical complaint associated with soccer (received during training or match play) that limits athletic participation for at	Incidence of ACL and ankle sprain in relation to playing position, leg dominance, and previous injury during	German National women's league	Significant association between the incidence of both ACL and ankle injuries and Previous injury: OR = 5.24 (95% CI, 1.42 - 19.59), p = 0.01

					least a day after the day of onset	one season from August 2003 to mid-June 2004		Specific playing position Defender: OR = 9.4 (95% CI, 7.4-11.4), p= 0.01 Striker: OR = 8.4 (95% CI, 6.0-10.8), p = 0.01 Leg dominance, p = 0.01
Ivarsson *et al.* (2013) Sweden	Prospective cohort study	Women (18), Men (38)	25.05 ± 5.46	To study if personality, stress, and coping predicted injury occurrence in an elite soccer population using a hypothesised model	A player is injured if they missed at least one practice or competition due to injury	Participants first completed Swedish Universities Scales of Personality, Life Events Survey for Collegiate Athletes, and Brief-COPE questionnaires, then the Hassle and Uplift Scale once weekly for 13	Swedish premiere league	Significant relationship between increased incidence of soccer injury and negative psychological state OR = 2.63 (95% CI, 0.039–0.044), p < 0.01

						weeks during competition		
Mohamed, *et al.* (2012) South Africa	Case control prospective study	24	18.92 ± 1.17	To investigate the association between Q-angle, pelvic width, and intercondylar notch width and knee injuries among the U23 female soccer players of South Africa	Not given	Association between knee injuries and Q-angle, pelvic width, and intercondylar notch width Participants were divided into groups: with or without previous knee injury	U-23 South African national team	No relationship between the incidence of knee injury Q angle measure p = 0.74, pelvic width p = 0.34, and width of intercondylar notch right p = 0.142, left p = 0.089 OR = Not provided
Nilstad *et al.* (2014) Norway	Prospective cohort study	173	21.5 ± 4.1	To investigate risk factors for lower extremity injuries in elite female soccer players	An injury was recorded if the player was unable to fully participate in soccer training or match play or at least 1 day beyond the day of injury	Screening injuries in one season and relating them to BMI, lower knee valgus angle, and previous injury	Norwegian elite soccer league	Incidence of lower limb injuries is associated with: Greater BMI: OR = 1.51 (95% CI, 1.21-1.90), p = 0.001 Lower knee valgus angle in drop jump landing:

								OR = 0.64 (95% CI, 0.41-1.00), p = 0.04 Previous knee injury: OR = 3.57 (95% CI, 1.27-9.99), p = 0.02
Roos and Ostenberg (2016) Sweden	Prospective cohort study	Elite: 32 Non-elite: 91	20.7 ± 4.6	To register prospectively the injuries in female soccer and to study their correlation to potential risk factors	An injury was registered if it resulted in an absence from scheduled activities for at least one practice game	Recorded injury in one season Measured BMI and joint laxity, isokinetic knee muscle strength, one leg hop, vertical jump, and continuous multistage fitness test before the season	Senior players from the 1st team of eight soccer clubs in the south of Sweden	Incidence of soccer injury was associated with Increased joint laxity: OR = 5.3 (95% CI, 2.0-13.5), p = 0.001 High performance in the functional test (square hop): OR = 4.3 (95% CI, 1.7-10.5), p = 0.002 Age over 25 years: OR = 3.7 (95% CI, 1.4-10.0) p = 0.01

Soderman *et al.* (2001) Sweden	Prospective cohort study	146	20.6 ±4.7	To study possible risk factors for leg injuries in female soccer players	Soccer-related injuries resulting in absence from at least one scheduled practice sessions or game were recorded by players in cooperation with their coach	Clinical examinations for joint laxity, postural sway of the legs, isokinetic measurements of quadriceps and hamstring torques, and hamstring to quadriceps ratio during concentric action Injuries recorded during one season	2nd and 3rd Swedish divisions	Incidence of soccer injury was associated with General joint laxity: OR= = 3.10 (95% CI, 1.19-8.01), p = 0.02 Hyperextension of knee joint: OR = 3.84 (95% CI, 1.51 – 9.78), p = 0.005 Low postural sway: OR = 0.31 (95% CI, 0.13 - 0.70), p = 0.005 Lower H/Q ratio during concentric action: OR = 0.93 (95% CI, 0.88 - 0.99), p = 0.02 Higher exposure to soccer: OR = 1.56 (95% CI, 1.02 - 2.37), p = 0.04

Steffen *et al*. (2017)	Prospective cohort study	Soccer: 429 Handball: 409	21.1 ± 4	To assess whether a previous injury or postural control was associated with an increased risk of ACL injuries in elite female players	Any injury occurs during a soccer game or practice	Balance platform, 3D motion analysis	Premier league	No significant association between static or dynamic postural control and the risk of soccer injury Significant relationship between previous and new ACL injuries: OR = 2.86 (95% CI, 1.44-5.69), p = 0.05

ACL, anterior cruciate ligament; BMI, body mass index; Brief-COPE, Coping Orientation to Problems Experienced Inventory (a brief questionnaire to measure athletes' coping strategies); EMG, electromyography; Q angle, the acute angle between the line connecting anterior superior iliac spine to the middle of the patella and the line connecting the tibial tuberosity to the centre of the patella; SD, standard deviation, OR Odds Ratio; CI, Confidence Intervals.

Table 2-3 Weight, Quality, and Level of Evidence for all Included Studies

	Faude et al. (2006)	Steffen et al. (2017)	Soderman et al. (2001)	Roos and Ostenberg (2016)	Ivarsson et al. (2013)	Mohamed et al. (2012)	Nilstad et al. (2014)	Blokland et al. (2017)	Evidence weight
Study quality on CASP	High	High	High	High	High	High	High	High	
Level of evidence on OCEBM	2	3	2	2	2	2	2	2	
Intrinsic factors									
Previous injury	+	+					+		+++ Strong
Joint hypermobility			+	+				-	++ - Strong
Lower H/Q ratio			+						+ Limited
BMI							+		+ Limited
Negative psychological state					+				+ Limited
Leg dominance	+								+ Limited
Anatomical structures						-			- No
Low postural sway			+						+ Conflicting
Lower knee valgus							+		+ Limited
High performance in functional test				+					+ Limited

Age over 25 years				+					+ Limited
Extrinsic factors									
Playing position	+								+ Limited
Higher exposure			+						+ Limited

+ Positive association between the risk factor and soccer injures, - No association between the risk factor and soccer injuries.

2.5.4.1 Intrinsic factors

Two studies investigated the impact of previous injury and reported an association with new soccer injury to the same anatomical location (Faude *et al.*, 2006; Nilstad *et al.*, 2014). Joint laxity (hypermobility) was investigated in four studies, with three studies (Söderman *et al.*, 2001; Faude *et al.*, 2006; Roos and Östenberg, 2016) finding a significant association between joint laxity and injury. In contrast, Blokland *et al*. (2017) found no relationship between soccer injury and general joint laxity. Additional significant anatomical risk factors for injury identified in the present review included: a hamstring to quadriceps (H/Q) ratio < 55% during concentric contraction of both quadriceps and hamstring tested at 90 degrees of knee flexion (Söderman *et al*., 2001); and increased BMI (Nilstad *et al.*, 2014). Individual differences in pelvic width, Q-angle measurement, and intercondylar notch width were not associated with injury (Mohamed *et al.*, 2012). Furthermore, Söderman *et al.* (2001) reported that increased age was significantly associated with soccer injury, and that higher postural control was found to be associated with a higher incidence of soccer injury. In contrast, Steffen *et al*. (2017) found no relationship between posture control and the risk of injury.

Better performance in the square-hop test (higher knee stability) (Roos and Östenberg, 2016) was significantly associated with increased lower limb injury. Poor performance in the drop jump landing test (poor landing mechanics) (Nilstad *et al.*, 2014) was also found to be significantly associated with increased ankle injury. In addition, a significant relationship between the incidence of soccer injury and trait anxiety, negative life-event stress, and daily hassle was reported by Ivarsson *et al.* (2013). A higher incidence of injuries was also reported in the dominant limb (Faude *et al.*, 2006).

2.5.4.2 Extrinsic factors

One study (Söderman *et al*., 2001) reported a significant association between increased soccer exposure during match play or training, and increased injury. Defenders and strikers were found to be at increased risk of ACL and ankle injuries (Faude *et al.*, 2006).

2.6 Discussion

This systematic review aimed to summarise risk factors associated with injury among elite women's soccer players. There is a need for evidence to guide research and interventions for preventing soccer injuries. Despite a paucity of and the heterogeneity in published prospective studies in this discipline, with few studies investigating each risk factor, this review represents an important first step in the synthesis of an evidence-based reference. This review has identified key risk factors based on the quality of the studies, the level of evidence, and the number of studies supporting the risk factor and has contextualised the findings in the supporting literature among similar populations. For example, previous injury was a risk factor of soccer injuries in three studies, all of which were of high quality (scored 12/12 on CASP checklist), their level of evidence was two on OCBEM, and supported by studies among elite handball women players. These criteria made "previous injury" a strong risk factor of soccer injuries in elite women's soccer.

Results suggest seven key intrinsic and extrinsic factors, and a few additional factors with limited evidence. These potential factors may render elite women soccer players vulnerable to injury, and they should be considered by the players, their coaches, and clubs to manage the risk of soccer injuries. Modifiable factors should be targeted by injury prevention interventions to reduce the risk of soccer injuries among women soccer players. To our knowledge, this review is the first to summarise risk factors of soccer injuries among elite women players and includes all types and severities of soccer injures. Its objective is to provide an efficient evidence-based reference for practitioners and researchers to reduce injuries in elite women's soccer.

2.6.1 Previous injury: Intrinsic/non-modifiable risk factor

A history of a musculoskeletal injury was found to be associated with a higher risk of future injury among elite female soccer players in two of the included studies (Faude *et al.*, 2006; Nilstad *et al.*, 2014). A previously injured limb was more susceptible to re-injury, especially in the same anatomical location. The incidence of future knee injury is higher among players with previously injured ACL (Faude *et al.*, 2006) by nine-fold (Nilstad *et al.*, 2014). A proposed cause for increased risk of re-injury was inadequate rehabilitation of a previous injury (Faude *et al.*, 2006).

Adequate rehabilitation is essential to overcome the changes in strength, proprioception, and kinematics presented in the injured site (Fulton *et al*., 2014). Similarly, a retrospective study among elite female soccer players revealed 76% of ankle injuries and 100% of shin injuries to result from a previous injury to the same anatomical location (Lilley *et al.*, 2002). Consistent findings were reported among elite female handball players as well (Fulton *et al*., 2014). Therefore, adequate rehabilitation (the restoration of the anatomical and functional levels required for return to play of a previously injured body part (Frontera, 2003)) and well-planned return to play protocols are crucial to avoid re-injury (Haxhiu *et al.*, 2015). Pre-season evaluation of previously injured players is also valuable to reduce injury rates, and to identify players more prone to injury in general (Hägglund *et al.*, 2013b). Finally, it is essential to bear in mind that complete restoration of the preinjury anatomical and functional levels is not always achievable (Yoo *et al.*, 2010). The rate of returning to preinjury levels is lower among women and older athletes, and decreased with poor psychological state of the injured player (Webster and Feller, 2019).

2.6.2 Joint hypermobility: Intrinsic/non-modifiable risk factor

The association between the risk of injury and joint hypermobility (laxity) was investigated in numerous studies in the present review (Söderman *et al.*, 2001; Roos and Östenberg, 2016; Blokland *et al.*, 2017). Generalised joint hypermobility of ≥ 4 on the Beighton (Juul-Kristensen *et al.*, 2007) score was found to lead to a five-fold increase in injury among affected players (Roos and Östenberg, 2016). Furthermore, knee joint laxity measured using the manual Lachman test was found to increase the risk of leg injuries (Söderman *et al.*, 2001). The suggested mechanism of this relates to decreased joint

proprioception, which renders the joint less sensitive to potentially damaging forces (Bjordal *et al.*, 1997). Similarly, a prospective study among elite male soccer players reported that joint hypermobility measured by the Beighton scale increased the incidence and severity of injuries among affected players (Kuijt *et al.*, 2012). However, Blokland *et al.* (2017) found no association between general joint hypermobility and increased soccer injury. Interpreting this result was complicated by the implementation of preventative programmes and methods (such as bracing/taping) during the observation period. These findings suggest that joint hypermobility may increase injury risk, and that this risk may be addressed by appropriate proprioceptive rehabilitation programs and/or the use of protective equipment. However, these findings require more investigation and must be interpreted with caution because of the confounding effect of bracing/taping on joint hypermobility.

2.6.3 Exposure: Extrinsic/modifiable risk factor

Higher soccer exposure measured as absolute external load (duration of exposure per unit of time) was associated with increased risk of injury, especially during a competitive match in one of the reviewed studies (Söderman *et al.*, 2001). Suggested explanations were higher levels of players' fatigue and decreased concentration, which were more pronounced in the latter stages of games (Söderman *et al.*, 2001; Lohmander *et al.*, 2004). Similarly, an observational study among professional soccer players which measured both the external load using the acute-chronic load ratio and the internal load using the player's rating of perceived exertion, reported an association between higher exposure and increased risk of injury (Malone *et al.*, 2017b). Therefore, appropriate individual load prescription, combined with monitoring the absolute internal/external load, are highly recommended, taking into consideration the rate of load changes for each player (Gabbett, 2016; Ross *et al.*, 2019). Identifying the individual player's perfect training stimulus 'sweet spot' is recommended as well, to optimise performance and limit the undesired training effects (Soligard *et al.*, 2016). Players are also advised to achieve adequate recovery from fatigue before the game/training session to avoid injuries (Kellmann *et al.*, 2018). Recovery is a multi-layered process in which the body restores its balance at all levels (e.g., physiological, biological, psychological) after it being disturbed by an internal or external factor such as sport-induced fatigue (Kellmann *et al.*, 2018).

2.6.4 Playing position: Extrinsic/modifiable risk factor

A further important factor associated with an increased risk of injury was the player's position on the field, as identified in one included study (Faude *et al.*, 2006). The risk of ACL and ankle injuries per 1000 hours of exposure in defenders (9.4 injuries) and strikers (8.4 injuries) was higher than it was for goalkeepers (4.8 injuries) and midfielders (4.6 injuries) (Faude *et al.*, 2006). Proposed causes were increased aggressiveness and contact with other players in areas close to goal (Faude *et al.*, 2006). Findings of the present review were supported by a study among elite male soccer players, which concluded that injury incidence was higher in areas of defending and attacking where playing was more aggressive (Parkkari *et al.*, 2001). Position-specific education and training are recommended to reduce risk of injury attributable to positional vulnerabilities (Faude *et al.*, 2006).

2.6.5 Age: Intrinsic/non-modifiable risk factor

Players older than 25 years of age were more susceptible to injury in one included study Söderman *et al.* (2001). Age-related changes in older athletes, such as increased body weight, loss of flexibility, and increased exposure to soccer have been mooted as contributory factors (Hägglund *et al.*, 2013b). Similarly, another study which aimed to examine the risk and incidence of injury among elite male soccer players between 14 and 41 years of age mentioned that player age is an important factor which influences the incidence, type (tissue affected), and severity of injury (Haxhiu *et al.*, 2015). Further studies are required to verify whether age is an independent risk factor for injury in this population.

2.6.6 Postural control: Intrinsic/modifiable risk factor

Two included studies investigated the association between postural control and the risk of soccer injury (Söderman *et al.*, 2001; Steffen *et al.*, 2017). Lower postural sway of both legs measured using the kinesthetic ability trainer 2000 (KAT, 2000) was associated with a higher incidence of lower-limb injuries among players (Söderman *et al.*, 2001). Soderman *et al.* (2001) suggested three hypotheses for their findings: (a) players with better postural control sustained more injuries in their attempt to avoid falling; (b)

exposure to a greater risk of injury through aggressive playing; and (c) the balance index of KAT 2000 was not a reliable measure of postural control. The authors' suggestion that the players with better postural control sustained more injuries as they attempted to avoid falling contradicts evidence that the risk of sport injuries is lower among players with better balance (Romero-Franco *et al.*, 2014; Dean *et al*., 2021). Their second suggestion (players with better balance were subjected to higher soccer exposure and more aggressive play) is more consistent with evidence (Schwebel, *et al.*, 2007; Soligard *et al.*, 2016). They also reported that the balance index KAT 2000 was either an invalid or unreliable measure of postural balance. Therefore, of the three possible explanations that they provided for the higher injuries among players with better balance, the most likely explanation is that it was caused by the higher exposure among that group. Using a balance platform and a 3D motion analysis system, an included study, Steffen *et al.* (2017) found that neither postural sway nor dynamic postural control increased the risk of ACL injury. The contradictory findings reported by the two included studies (higher incidence of injuries with better postural balance (Söderman *et al.*, 2001) and higher risk of injuries with low postural balance (Steffen *et al.*, 2017)) could be explained by the different methodologies used in each study. Further studies using valid and reliable assessment tools are required.

2.6.7 Anxiety and stress: Intrinsic/non-modifiable risk factor

Psychological factors such as trait anxiety, negative life events, and daily hassle were significantly associated with soccer injuries among elite women players in one included study (Ivarsson *et al.*, 2013). It was proposed that these players exhibit psychosomatic trait anxiety, consider minor situations to be stressful, have higher levels of irritability, self-blame, and poor adaptive and coping abilities, leading to decreased physiological function, thus increasing the possibility of injury (Ivarsson *et al.*, 2013). Similarly, the aforementioned psychological factors were significantly associated with increased incidence of soccer injury in a prospective Swedish study among male senior soccer players (Ivarsson and Johnson, 2010). Therefore, regular monitoring of players' psychological state followed by appropriate intervention where required is necessary to maintain the mental and psychological well-being within this group.

2.6.8 Additional risk factors

Reviewed studies provided limited evidence to support an association between several functional and anatomical risk factors and injury among elite women soccer players. These factors include: a better performance in a functional square-hop test (Söderman *et al.*, 2001), excessive lower knee valgus in drop jump landing test (Roos and Östenberg, 2016), and an H/Q ratio < 55% during concentric contraction of both quadriceps and hamstring tested at 90 degrees of knee flexion (Söderman *et al*., 2001). Additionally, an increased incidence of injury was recorded in players with higher BMI (Nilstad *et al.*, 2014). Injury incidence was not found to be affected by individual differences in Q-angle, intercondylar notch width, and pelvic width measurements (Nilstad *et al.*, 2014). Finally, the present review showed that women soccer players sustained more injuries in their dominant limb (Faude *et al.*, 2006).

The present review reveals prospective studies exploring external and societal risk factors among women soccer players to be rare (only two studies investigated the effect of soccer exposure and playing position). Sports injury results from an interaction between internal and external risk factors (Bahr and Krosshaug, 2005). Furthermore, the interaction of risk factors may influence both the impact of the risk factor and the probability of injury (Meeuwisse *et al.*, 2007). For example, playing on high-friction floors (an external risk factor) increases the risk of ACL injuries among athletes with hypermobile knees (an internal risk factor) (Bahr and Krosshaug, 2005). Hence, future prospective investigations of the external risk factors of soccer injuries among women soccer players are required to inform injury prevention programmes among this population.

2.6.9 Limitations

Both the low number of included studies and the limited number of studies for each risk factor may be considered the main limitations of this review. The CASP tool used for critical appraisal in this review also contains no detailed scoring to evaluate methodologies, resulting in possible over-scoring of some studies.

2.7 Conclusion

Risk factors for injury in elite female soccer players are multifactorial, interwoven, and complex. The present review has summarised several factors that may inform injury screening in these athletes. However, there is a paucity of high-quality trials which investigate these factors in large, homogeneous cohorts. Further prospective studies using clearly defined and strong outcome measures are required, with a focus on the impacts of external factors such as climate and society, and female-related factors such as changes in female hormones. The present review calls for further high-quality research among elite female soccer players to achieve adequate evidence to provide prevention guidelines and management strategies specifically dedicated to this cohort.

2.8 Epilogue

The present systematic review contributes novel findings regarding evidence in the area of risk factors among women who play soccer, which guides research in the ensuing two chapters. This represents the first comprehensive systematic review to explore risk factors for injuries (for all types and anatomical locations of soccer injuries) among elite women soccer players. The synthesis presented herein provides an evidence-based foundation for specialists in the field, and guidance for further studies on injury prevention among soccer-playing women. Joint hypermobility and previous injury are identified as strong predictors of injuries among elite women soccer players, with higher soccer exposure, advanced player age, and anxiety, all contributing to increase the risk of injury among this cohort. These factors must be considered when introducing injury-prevention training and education tailored to women soccer players. Finally, this review also highlights the limitations of existing research, with few high-quality studies exploring the risk factors among women soccer players at different levels having been identified. This justifies the recommendation for further research in these disciplines.

To identify prospective studies that explore risk factors for soccer injuries among elite women soccer players published subsequent to completion of this review, the same search steps performed in the original review were repeated between September 2019 and August 2021. The search was conducted in accordance with PRISMA (Figure 2-2), and the quality assessment of the resulting study was carried out using CASP (Table 2-4). Since publication of this systematic review, one further prospective study exploring the risk factors for soccer injury among elite women was identified (Versteeg *et al.*, 2021)— a study that aimed to identify the risk factors for hamstrings and lower back injuries, and reported these injuries to increase significantly with higher soccer exposure during matches or training sessions (Table 2-5). Therefore, Versteeg *et al.* (2021) provides further support to findings reported by Alahmad *et al*. (2020), and again herein, regarding the significance of relationships between higher soccer exposure during matches or training sessions and soccer injuries.

Figure 2-2 PRISMA Flow Diagram for the new search

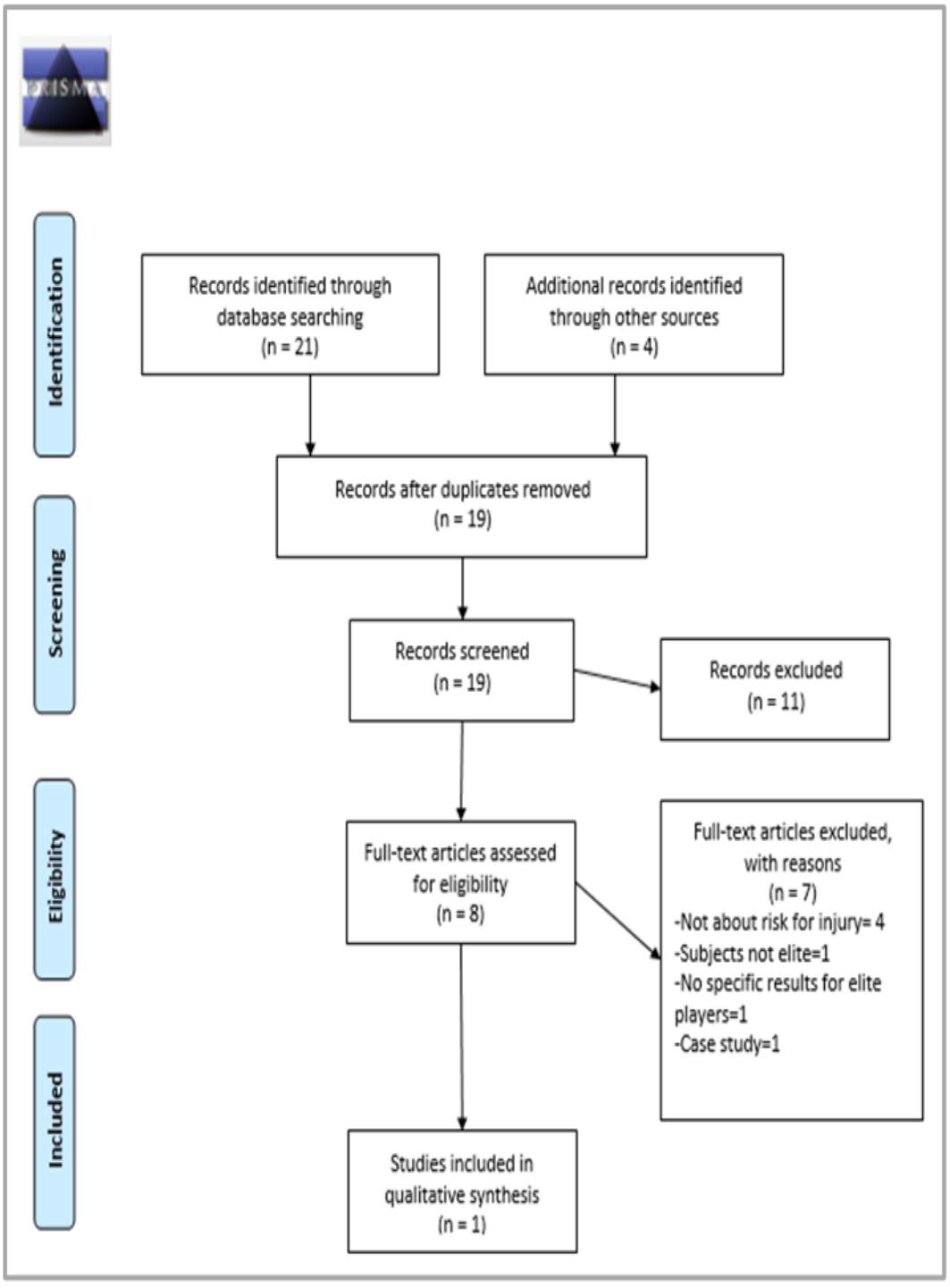


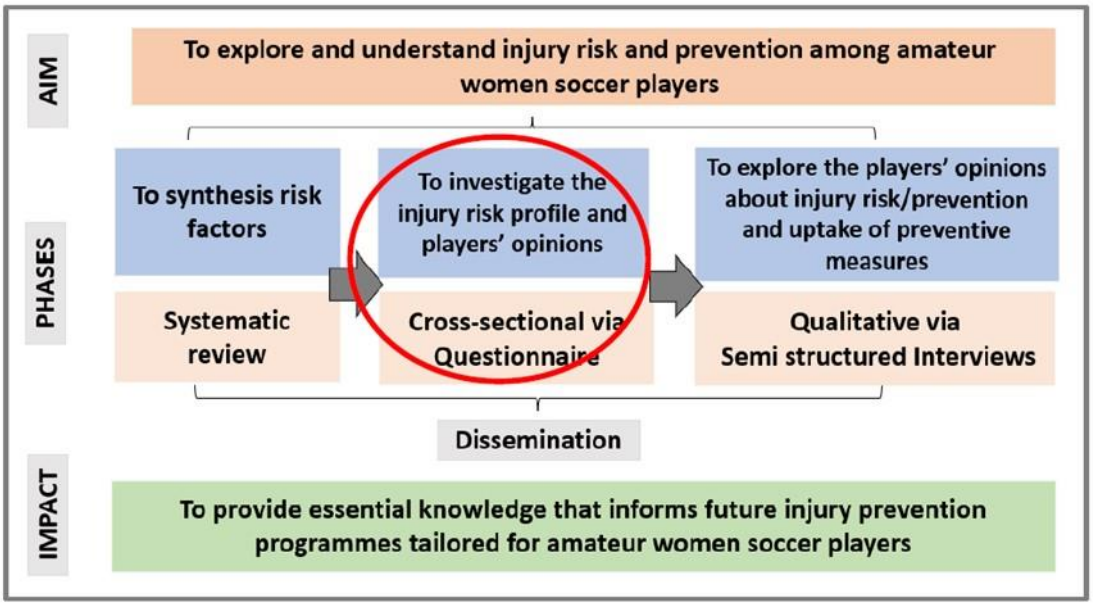
Table 2-4 CASP checklist for the cohort study (Versteeg *et al*. 2021)

Question	Score
Did the study address a clearly focused issue?	Yes
Was the cohort recruited in an acceptable way?	Yes
Was the exposure accurately measured to minimise bias?	Yes
Was the outcome accurately measured to minimise bias?	Yes
Have the authors identified all important confounding factors?	Yes
Have they taken into account the confounding factors in the design and/or analysis?	Yes
Was the follow-up with subjects complete enough?	Yes
Was the follow-up with subjects long enough?	Yes
What are the results of this study?	Yes
How precise are the results?	Yes
Do you believe the results?	Yes
Can the results be applied to the local population?	Yes
Do the results of this study fit with other available evidence?	Yes
What are the implications of this study for practice?	Yes
Overall quality	High

Table 2-5 Summary of research findings by Versteeg *et al*. (2021)

	Versteeg *et al.* (2021): Netherlands
Study design	Prospective
No of participants	114
Age Mean ± SD	22.4 ± 3.3 y
Primary aim of the study	To 157 determine whether hamstrings and lower back-flexibility is associated with hamstrings and lower back injuries in elite female soccer players.
Injury definition used for pain or injury	Time loss and non-time loss definitions were used
Factors investigated	In-season hamstring and lower back flexibility was assessed using the Sit-and-Reach test 74 (SRT) and soccer exposure and soccer-related injuries
Athlete affiliation	Elite
Findings	1 hour increase in match exposure significantly increases the risk of hamstrings and low back injuries by 1.051, p = 0.02

Chapter 3 Cross-sectional study



The corresponding research stage

Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies

Alahmad TA, Tierney AC, Cahalan RM, Almaflehi NS, Clifford AM. Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies. *Phys Ther Sport*. 2021;50. doi:10.1016/j.ptsp.2021.05.008

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	Designed analysis	Collected or conceived data	Analysis or interpretation	Drafted paper	Critical revision of article/approval for publication
Tahani Alahmad	Yes	Yes	Yes	Yes	Yes
Amanda Clifford	Yes	No	No	No	Yes
Audrey Tierney	Yes	No	No	No	Yes
Roisin Cahalan	Yes	No	No	No	Yes
Philip Kearney	Yes	No	No	No	Yes
Nassr Almaflehi	No	No	Yes	No	Yes

3.1 Prologue

This chapter presents a cross-sectional study designed to achieve the second aim of this research project. This research is the first to explore injury risk profile and opinions on injury risk factors and prevention measures among Irish amateur women soccer players. Investigating the injury profile and prevalence of risk factors in this chapter contributes to the first stage of TRIPP model (injury surveillance to establish the extent of a problem). This chapter provides a snapshot of the injury profile and prevalence of risk factors among Irish amateur women soccer players during the preceding winter season. In Ireland, amateur women's soccer teams play either during winter (winter leagues) or summer (summer leagues), with each being considered a full season.

Changes in the weather can affect a player's performance (heat accelerates the development of fatigue) (Mohr *et al.*, 2012), as well as the playing surface, which influence injury epidemiology (Eirale *et al.*, 2017). Therefore, in the present study, data were collected only over one season to minimise any effect of fluctuating weather on injury reporting. The risk factors that are explored in this research were extrapolated from the previous chapter (systematic review) because of a lack of prospective studies exploring risk factors among amateur women soccer players. Informed by learnings gained from this research, further studies could be conducted, for example, through successive winter seasons, or to compare findings reported herein with those of studies conducted during other seasons.

The manuscript based on this chapter was published in the peer-reviewed journal *Physical Therapy in Sport* (Alahmad *et al*., 2021).

3.2 Abstract

Objective: To explore injury profile, opinions on risk factors, and injury prevention among Irish amateur women soccer players

Design: A cross-sectional online survey

Setting: Irish amateur winter league

Participants: Active players ≤ 18 years of age

Main outcomes: Differences were found between injured and uninjured groups, and risk factors that significantly predict soccer injury were identified

Results: 168 injuries were reported by 83 participants during the winter season. An increased prevalence of competition anxiety was observed (53.8%, n = 85 participants) when compared with other risk factors. There was a negative association between injuries and participants' general health state (OR = 0.820, 95% CI 0.7–0.9, p = 0.007). Participants' knowledge about some risk factors including playing position, joint hypermobility, and playing during menses contradicts current evidence. Half of the participants (n = 67) had received no education on injury risk or prevention.

Conclusion: Fatigue was the highest reported subjective health complaint (SHC), the highest negative subscale of profile of mood state (POMS), and the highest perceived risk factor for injury, which calls for future load-management studies. More than half of the participants played in different positions, and their opinions on risk factors and preventive measures both concurred and contradicted the evidence. Further research is required to confirm the findings and explore the implementation of injury prevention strategies.

Keywords: women's soccer, injury prevention, opinions, risk factors

3.3 Introduction

Women's participation in soccer became increasingly popular (Ruiz-Esteban *et al.*, 2020) over the last decade, with approximately 30 million players reported worldwide (Del Coso *et al.*, 2016). In Ireland, the number of registered players in women's soccer leagues increased almost 100% between 2000 and 2006 to reach 6500 female players (Liston, 2006). However, despite this increasing participation, research exploring injury risk among this cohort of players is scarce (Sentsomedi and Puckree, 2016).

Recent changes in the social perspective towards gender differences have increased interest in female soccer (Ruiz-Esteban *et al.*, 2020). Findings from studies involving males cannot be generalised to females (Altavilla *et al.*, 2017; Pedersen *et al.*, 2019) because of gender-associated differences in performance, responses, and fatigability (Altavilla *et al.*, 2017). Female players were found to perform at a slower speed, cover shorter total distances, and exhibit earlier fatigue and decreased performance later in the game when compared with their male peers (Pedersen *et al.*, 2019).

Soccer is a complex, high intensity, contact sport, associated with a considerable risk of injury (Faude *et al.*, 2006), with injury negatively impacting the league; team performance (Hägglund *et al*., 2013a), and player well-being (Faude *et al.*, 2006). These consequences include kinesiophobia (fear of movement), negative psychological effects such as anxiety (Tripp *et al.*, 2011), and transient neurological impacts in the case of concussion (Mooney *et al.*, 2020). Higher risk for future osteoarthritis (Prien *et al.*, 2017), permanent changes in psychomotor function (Mooney *et al.*, 2020), and early retirement (Sadigursky *et al.*, 2017) also affect the injured player (Hägglund *et al.*, 2013a). Therefore, football associations are encouraging injury prevention programs to decrease the incidence of injury and the resulting time loss among players (Bisciotti *et al.*, 2019).

Several risk factors increase the incidence of soccer injury among elite women players, including previous injury, higher soccer exposure, joint hypermobility, and playing position (Alahmad *et al.*, 2020). However, these factors may not be transferable to amateur women due to differences in physical performance, amount of soccer exposure, and skills between the two levels (Lorenz *et al.*, 2013). Few studies have investigated amateur women soccer players. A Spanish study among amateur women soccer players

reported a higher rate of injuries during matches when compared with training sessions, for most injuries to be severe, and for the knee and ligaments to be mostly affected (Del Coso *et al*., 2016). A study among South African amateur women soccer players identified the ankle and knee to be the most commonly affected anatomical locations, for ligaments to be the most-affected structure, and for defender and goalkeeper positions to be more susceptible to injury (Masenya *et al*., 2019).

Several factors can confound the incidence of injury, including regional differences such as climate, culture (Eirale *et al.*, 2017), playing style (Waldén *et al.*, 2013), and playing level. One study showed that women soccer players from northern Sweden to sustain more match injuries when compared with their more southern peers, which was partly attributed to the different climates of the two regions (Jacobson and Tegner, 2007).

Injury prevention programs are encouraged to reduce the incidence of injury (Wilke *et al.*, 2018) by mainly targeting risk factors that could be modified through training or behavioural changes (Elise, 2017). According to the theory of planned behaviour, peoples' knowledge about a specific subject can be used to predict their intentions and behaviour, and the accuracy of the information they have may influence that ability (Ajzen *et al.*, 2011). Players' knowledge of injury risk and prevention influences their uptake of prevention programs and, therefore, influences the risk of injury (McKay *et al*., 2014). Compliance with prevention programs decreased the risk of soccer injury between 30% and 50% among female (Soligard *et al.*, 2010) and male (Silvers-Granelli *et al.*, 2019) youth players. To increase players' compliance with prevention programs, player's beliefs about risk factors and injury-prevention strategies must be explored and modified where appropriate (Zech and Wellmann, 2017). Studies into soccer players' beliefs concerning injury risk and prevention are rare. Two studies among male soccer players reported that previous injury, fatigue (McCall *et al.*, 2014) and playing position (Zech and Wellmann, 2017) were believed to be important risk factors by participants in these studies.

The aim of this present research is to explore the injury profile and prevalence of soccer related risk factors, as well as players' opinions on risk factors and injury prevention strategies, among amateur women soccer players in the Republic of Ireland (Ireland).

3.4 Methods

3.4.1 Participants

Ireland is a small country, and the impact of regional differences (weather (Kottek *et al.*, 2006), playing organization, and playing style) is minimal. Ireland includes the four counties/ Provinces of North/Ulster, South/Munster, East/Lienster, and West/Connacht. Accurate information regarding the number of amateur leagues in each region was unavailable upon designing the study. The number of teams identified from the Football Association Ireland (FAI) website was 134 (FAI.ie, 2019). Women's amateur soccer teams in Ireland play either in a winter or summer league, with each considered to represent a full season. Players from winter leagues (that played between September 2019 and March 2020) were invited to participate in this cross-sectional study. The primary author (TA) contacted the gatekeepers (team coach, team manager, secretary, team captain, referee, or physiotherapist) to explain the study and request distribution of the survey link to eligible players. Consent was obtained electronically as a part of the survey. Inclusion criteria required players to be active (current player in her team), 18 years and older, and to be from an Irish amateur soccer winter league team.

3.4.2 Study tool

An online survey was designed based on a similar published study among male soccer players (Zech and Wellmann, 2017). The survey included three sections:

3.4.2.1 Section 1

This section sought information about the participant's age, weight, height, team, position of play, and age of puberty (age at the first period in females (Klentrou, 2006)). The participant's weekly training load for all physical activities was measured using internal (Rating of Perceived Exertion (RPE)) and external (frequency and duration) load measures. This section included questionnaires to ascertain the prevalence of specific non-modifiable (hypermobility) and modifiable (mood, anxiety, general health state, and sleep) risk factors of soccer injury. The risk factors in this section were extrapolated from a systematic review of elite female soccer players (Alahmad *et al.*, 2020) and similar

studies (Biggins *et al*., 2018; Driller *et al*., 2018; Singh and Punia, 2019; Sajedi and Kirkbir, 2020; Silva *et al*., 2020) (Table 3-1).

3.4.2.2 Section 2

This section addressed soccer injuries sustained in the previous playing season, either during a match or a training session, which resulted in a restriction of soccer participation for one or more days (Kenny *et al*., 2018). Severity was determined by the number of days lost from matches or training sessions: minimal (1–3 days), mild (4–7 days), moderate (8–28 days), and severe (> 28 days) (Larruskain *et al*., 2017). 'Recurrent injuries' are those that occurred at the same site as the original injury after four weeks from return to play (Fuller *et al*., 2006). 'Injury location' (affected body part) and 'injury type' (nature of lesion) have been defined according to a consensus of studies into soccer injuries (Fuller *et al*., 2006). The number of injuries per player was calculated from the total number of injuries sustained during the previous playing season divided by the total number of players (Del Coso *et al*., 2016). To minimise the risk of recall bias, participants reported injuries in the immediate past winter playing season (recall period ≤ 7 months) using clear direct questions (Althubaiti, 2016).

3.4.2.3 Section 3

Part 1: In the first section of the survey, we investigated the prevalence of several risk factors. In this part, we asked the participants if they see those risk factors as causes of soccer injury. Furthermore, additional, previously identified risk factors among women soccer players (Hunt, 2003; Jacobson and Tegner, 2007; Borotikar *et al*., 2008; Gravina *et al*., 2012; Smith *et al*., 2012; Roos and Östenberg, 2016; Alahmad *et al*., 2020) were included to ascertain participants' knowledge regarding intrinsic (previous injury, poor diet, and deficits in fitness, strength, coordination, balance, and attention) and extrinsic (shoes, flooring, and climate change) risk factors. These additional risk factors were not included in section 1 as some factors are difficult to assess through self-reporting.

Part 2: Sought information on participants' education about injury prevention (provider, format, when the education was completed) and if the player felt sufficiently informed about injury prevention.

Part 3: Prevention strategies in this part were informed by the risk factors in section 1 and the literature (Mandelbaum *et al*., 2005; Bahr and Krosshaug, 2005; Pollard *et al*., 2006; Jacobson and Tegner, 2007; Alentorn-Geli *et al.,* 2009; Soligard *et al.,* 2009; Gravina *et al.,* 2012; Smith *et al.,* 2012; Blokland *et al*., 2017; Alahmad *et al.,* 2020). Prevention strategies were sub-categorised as either intrinsic or extrinsic. The participant's level of knowledge of injury risk and general prevention strategies of soccer injuries was evaluated by comparing their opinions on a five-point Likert scale, to the evidence. The findings between injured and uninjured groups were compared to explore the impact of the participants' knowledge on their preventive behaviours (Ajzen *et al*., 2011).

3.4.3 Pilot testing of the survey

Piloting was conducted to check the wording, clarity, and timing of the survey with one recreational soccer player, one recreational runner, three PhD students experienced in the use of questionnaires, and a master's student with no soccer background. The survey required no amendments and took less than 20 minutes to complete.

Cronbach's alpha was used to measure the internal consistency of the items in the participants' opinions scales (risk factors and prevention measures) and the reliability of these scales.

Cronbach's alpha for parts 1 and 2 in section 3 was 0.972, which is higher than the recommended value of 0.95, indicating the redundancy of some items (Tavakol and Dennick, 2011). Redundant risk factors included: wearing a protective device/wearing low-quality shoes, inadequately treated previous injury in the same body part/inadequately treated previous injury in a different body part, and older age/younger age. Redundant prevention measures included: increased fitness/increased agility, taping/using suitable footwear or orthosis/use of protective equipment, and management of psychological stress/management of anxiety and increased fitness/increased agility. Several trials were conducted to reduce the value of Cronbach's alpha by removing one item from each pair. These trials reduced the value of Cronbach's alpha to be between 0.92 and 0.79. However, according to literature in this discipline, the redundant pairs of items (e.g., inadequately treated previous injury in the same body part, and inadequately

treated injury in a different body part) could not be merged into one item (Nilstad *et al.*, 2014). Therefore, the high value of Cronbach's alpha was accepted.

Table 3-1 Questionnaires used in part 1 of the survey

Questionnaire	To assess	Psychometric properties	Score range	Score interpretation
Subjective Beighton scale (Velasco-Benítez *et al.*, 2019)	Self-reported joint hypermobility	Feasible tool used with high to moderate reliability (Kappa coefficient between 0.81 and 1.00, interclass correlation 0.9) (Velasco-Benítez *et al.*, 2019)	0–9	Score of ≥ 4 indicates general joint laxity
Profile of Mood States (POMS) (Grove and Prapavessis, 1992)	Total mood disturbance (TMD)	Valid, reliable and sensitive to changes that take place over time (Grove and Prapavessis, 1992) Internal consistency (alpha coefficients) between 0.72 and 0.84 (Biggins *et al.*, 2018)	24–124	Higher scores indicate higher mood disturbance (Turner *et al.*, 2017)
Sport Competition Anxiety Test (SCAT) (Allie *et al.*, 2018)	Level of anxiety an athlete experiences before competition	Valid and reliable among individual athletes and team sports (Judge *et al.*, 2016) Test-retest reliability between 0.73 and 0.88, internal consistency between 0.95 and 0.97 (Allie *et al.*, 2018)	10–30	Scores correspond to levels of sport competition anxiety: Low: < 17 Average: 17 < 24 High: > 24

Subjective health complaints (SHC) inventory (Tschudi-Madsen *et al.*, 2011)	General health state by reporting the presence of 13 health complaints	Good internal consistency among women (Tschudi-Madsen *et al.*, 2011) Internal consistency (Cronbach's alpha) = 0.82 (Biggins *et al.*, 2018)	0–13	Higher score reflects decreased general health
Athlete Sleep Screening Questionnaire (ASSQ) (Driller *et al*., 2018)	The player's sleep quality	Valid among athletes, 81% diagnostic sensitivity (Driller *et al*., 2018)	0-17	Scale scores corresponding to clinical sleep categories: None: 0-4 Mild: 5-7 Moderate: 8-10 Sever: 11-17

3.4.4 Data analysis

Data were exported from Survey Monkey into SPSS version 25 for analysis. Injury data are presented using the number and percentage of injuries for each category. Categorical data are presented using the number and percentage of participants for each category. Data were analysed with the assumption that the means are normally distributed as the sample sizes were > 30 (Krithikadatta, 2014). Hence, mean ± standard deviation (SD) was used to express continuous data, and independent t-tests were used to assess the significance of differences in the prevalence of continuous variables between injured and uninjured groups. A Chi-square test was used to evaluate the significance of differences in categorical variables between injured and uninjured groups (the level of significance was set at $\alpha = 0.05$). The dependent variable in this study was 'injury occurrence in the previous playing season.' Univariate logistic regression analysis was performed to examine the association of all variables (risk factors) with soccer injury occurrence in the last season (as the dependent variable). Only risk factors that showed a significance level at $p \leq 0.2$ in the primary univariate regression analysis were included in multi-regression

analysis, to avoid overfitting variables and examine all potential risk factors (Cecatto *et al*., 2015). The multi-regression analysis was adjusted for the variables 'age' and 'play in more than one position.'

F and Likelihood ratio tests were used to test the model's goodness-of-fit, and Nagelkerke R^2 was used to measure the percentage of total variation for injury occurrence that could be explained by the model. Regression results are presented as an odds ratio (OR) and their respective 95% confidence intervals (the significance level was set to 0.05 for the final model).

3.5 Results

Approximately 268 active women players from amateur soccer winter leagues were invited to take part in this study, with 158 players agreeing to participate. The final sample size represents 10.7% of the total playing population (1474 players), which represents a sufficient sample size according to Conroy (2016). The response rate was estimated at 58.9% (data were collected between 15 October 2019 and 1 May 2020). Out of 158 players who responded, only 85.4% (135 players) completed all three sections of the questionnaire; all responses (including incomplete ones) were analysed. The number of responses from the southern province (51.3%, n = 81) was the highest when compared with responses from other Irish provinces (Table 3-2).

Table 3-2 Number and percentage of respondents by Irish county/province

Irish County/Province	Total number of teams	Total number of players (number of teams × 11)	Number of respondents	Percentage from the total number in the county	Percentage from the total number of respondents
North/Ulster	8	88	2	2.3	1.3
South/Munster	52	572	81	14.2	51.3
East/Leinster	62	682	22	3.2	13.9
West/Connacht	12	132	48	36.4	30.4
Total	134	1474	158		

Table 3-3 Demographics of amateur women soccer players who participated in this study

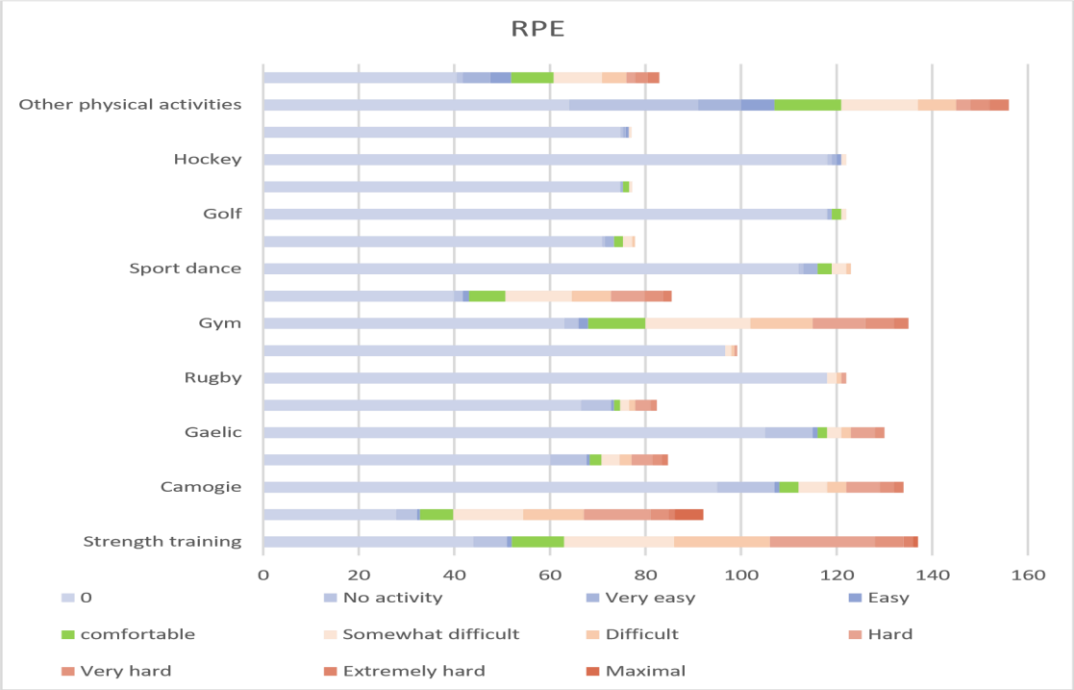
Item (n)		
Age: years	Mean ± SD 25.4 ± 7.7	
Age of puberty: years (n = 154)	Mean ± SD 12.73 ± 1.45	
BMI: kg/m^2 (n = 157)	Mean ± SD 23.9 ± 3.9	
Playing in more than one position (n = 157)	Yes	61.4 %; n = 97
	No	38.0 %; n = 60

BMI: body mass index.

3.5.1 Demographics

Means of participant age (25.4 ± 7.7 years) and BMI (23.9 ± 3.9 kg/m^2) place the group in the normal weight category (18.5–24.9 kg/m^2) (Anuurad *et al*., 2003). Of participants, 61.4% played in more than one position (n = 97) (Table 3-3). Participants engaged in various physical activities during the week, but the highest proportions were for strength training (86.7%, n = 137) and gym-based activities (85.4%, n = 135). The weekly training load of participants, measured in rating of perceived exertion (RPE) for each physical activity is presented in Figure 3.1 below. This figure represents the participants' RPE during a typical week. The vertical axis represents nine categories of physical activities. The horizontal axis represents the number of participants in each RPE category (0, no activity, very easy….) presented in colours. The participants' RPE for each physical activity is represented by two lines: upper, the RPE of uninjured participants, and lower, the RPE of injured participants. For example, in a typical week, the RPE of ~77% of uninjured participants was "no activity" for Hocky. The total training load for all physical activities (except soccer) during the week was 6.40 ± 4.59 sessions and 7.55 ± 5.42 hours. The total training load for all physical activities (including soccer) during the week was 8.6 + 5.69 sessions and 10.55 + 7.12 hours. There were no significant differences in the training load between injured and uninjured groups for any of the variables (frequency, duration, and RPE), p values > 0.3.

Figure 3-1 RPE among amateur women soccer players participated in this study



3.5.2 Injury profile

145 participants (91.8% of the original 158 participants) responded to section two of the questionnaire. Eighty-three out of these 145 participants (57.2%) sustained at least one soccer-related injury in the previous season. Participants had sustained a total of 168 injures, with 4.1% (n = 6) sustaining an injury on five occasions during their last playing season; there were 1.06 injuries per player. Injuries occurred most frequently during matches (58.9%, n = 99) when compared with training sessions (29.2%, n = 49). New injuries (48.2%, n = 81) were higher than recurrent (35.1%, n = 59) injuries. Of categories, the prevalence of moderate injuries (26.8%, n = 45) was greatest; contact injuries (58.3%, n = 98) were more common than non-contact injuries (30.4%, n = 51) (Table 3-4). Contact injuries (74.7%, n = 74) were higher than non-contact injuries (21.2%, n = 21) during matches, while contact injuries (44.9%, n = 22) were less than non-contact injuries (51.0%, n = 25) during training sessions. Lower-limb injuries accounted for 56% (n = 94) of all injuries, with the knee (20.2%, n = 34) the most frequently affected area (Figure 3-2). Ligaments (26.8%, n = 45) and muscle injuries (25%, n = 42) were the most common types of injury (Figure 3-3). Also, ligamentous injuries (matches 29.3%, n = 29; training

30.6%; n = 15) were more common than muscle injuries (matches 20.2%, n = 20; training 26.5%, n = 13) during both matches and training sessions.

Figure 3-2 Anatomical locations of injuries among participants who sustained soccer injuries in the previous season

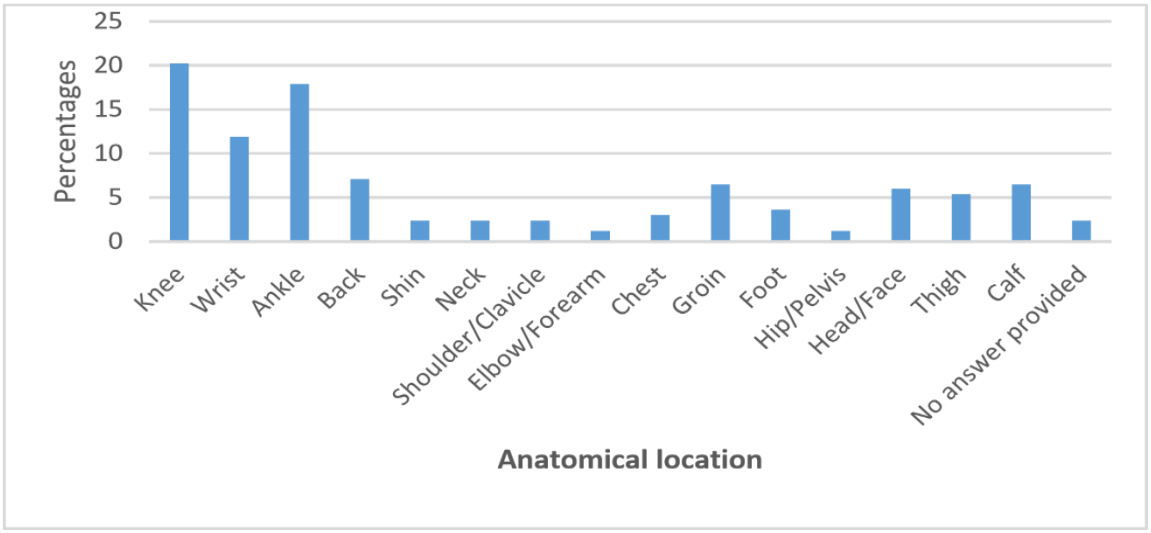


Figure 3-3 Types of injuries among participants who sustained soccer injuries in the previous season

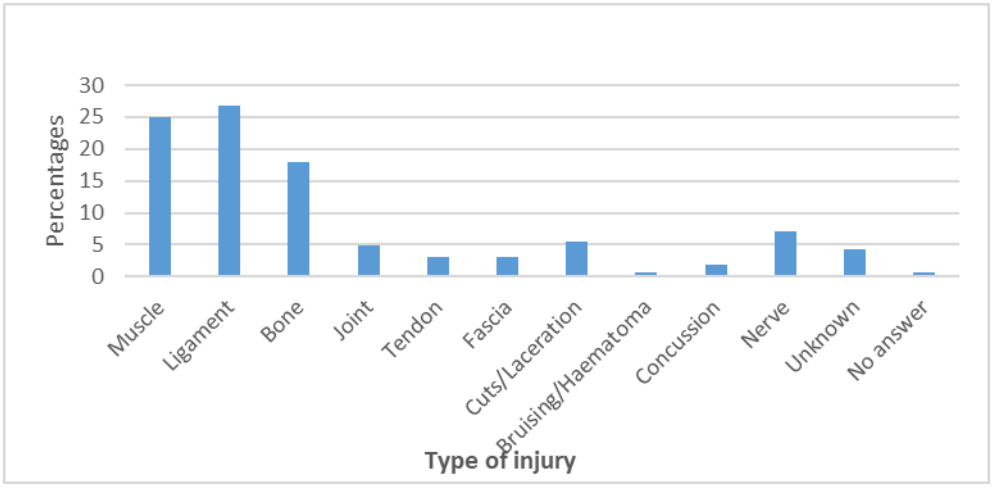


Table 3-4 Injury characteristics among participants who had sustained soccer injuries in the previous season

Item		Number and % who injury n	 %
Severity (days lost from soccer games and practice)	Minimal 1–3 days	22	13.1
	Mild 4–7 days	42	25.0
	Moderate 8–28 days	45	26.8
	Severe > 28 days	33	19.6
	Do not remember	15	8.9
	No answer	11	6.5
Recurrence (reinjury within 4 weeks from return to play)	New	81	48.2
	Recurrent	59	35.1
	Do not remember	22	13.1
	No answer	6	3.6
During which event Match/ training session	Match	99	58.9
	Training session	49	29.2
	Do not remember	12	7.1
	No answer	8	4.8
Contact	Yes, with another player	75	44.6
	Yes, with an object	23	13.7
	No	51	30.4
	Do not remember	11	6.5
	No answer	8	4.8

3.5.3 Prevalence of risk factors among all participants

Table 3-5 presents the prevalence of risk factors among all participants. Sport competition anxiety showed increased prevalence when compared with other risk factors, whereby 53.8% of participants reported average competition anxiety (n = 85). Subscales of the SHC

showed that severe (general) anxiety (6.3%, n = 10) and tiredness (9.5%, n = 15) were more prevalent among participants compared with other SHCs (Table 3-6). The mean and SD of the negative subscales on POMS were tension = 5.65 ± 4.7, anger = 2.43 ± 3.06, depression = 3.53 ± 4.57, fatigue = 6.31 ± 4.5, and confusion = 4.44 ± 3.4. The mean and SD of the positive subscales on POMS were vigour = 7.99 ± 3.93 and esteem-related affect = 14.63 ± 3.31. Fatigue had the highest mean value compared with other negative subscales (7 ± 5.72).

Table 3-5 Prevalence of risk factors among amateur women soccer players participated in this study

n/158	Category	n	%
Female hormones intake; n = 156	No	105	66.5
	Yes	51	32.3
Joint hypermobility (Beighton scale); n = 154	No	88	55.7
	Yes	66	41.8
Rating of perceived exertion during a working session of soccer, using the modified Borg CR-10 (Malone *et al*., 2017b); n = 145	No activity	3	1.9
	very easy	3	1.9
	Easy	3	1.9
	Comfortable	40	25.3
	Somewhat difficult	37	23.4
	Difficult	25	15.8
	Hard	16	10.1
	Very hard	10	6.3
	Extremely hard	8	5.1
Clinical sleep problem category; n = 148	None	31	19.6
	Mild	65	41.4
	Moderate	30	19.0
	Severe	22	13.9
Competition anxiety level; n =	Low	34	21.5

148	Average	**85**	**53.8**
	High	29	18.4
Playing position; n = 157	Goalkeeper	19	12.0
	Defender	18	11.4
	Attacker	60	38.0
	Midfielder	24	15.2
	Forward	36	22.8
Age: years; n = 158		Mean ± SD 25.4 ± 7.7	
Body mass index (kg/m^2); n = 157		Mean ± SD 23.9±3.9	
Soccer duration: hours per week; n = 143		Mean ± SD 3 ± 1.7	
Soccer frequency: sessions per week; n = 146		Mean ± SD 2.2 ± 1.1	
Score on subjective health complaints; n = 136		Mean ± SD 4.74 ± 2.9	
Total mood disturbance; n = 150		Mean ± SD 101.5 ± 18.2	

Table 3-6 Subjective Health Complaints (SHC) among the Study Participants (amateur women soccer players)

Symptom	Not at all		A little		Some		Severe		Total n
	n	%	n	%	n	%	n	%	
Palpitation	99	62.7	31	19.6	16	10.1	2	1.3	148
Chest pain	119	75.3	19	12.0	8	5.1	2	1.3	148
Breathing difficulties	96	60.8	42	26.6	8	5.1	2	1.3	148
Heart burn	120	75.9	18	11.4	9	5.7	1	0.6	148
Stomach discomfort	81	51.3	45	28.5	21	13.3	1	0.6	148
Diarrhea	119	75.3	15	9.5	13	8.2	1	0.6	148
Constipation	117	74.1	22	13.9	9	5.7	-	-	148
Eczema	131	82.9	5	3.2	9	5.7	3	1.9	148
Tiredness	19	12.0	70	44.3	44	27.8	15	9.5	148
Dizziness	104	65.8	33	20.9	11	7.0	-	-	148
Anxiety	57	36.1	48	30.4	33	20.9	10	6.3	148
Sadness	87	55.1	43	27.2	16	10.1	2	1.3	148
Sleep problems	67	42.4	50	31.6	24	15.2	7	4.4	148

3.5.4 Participants' opinions/beliefs of injury risk and prevention strategies

Figure 3-4 outlines participants' opinions on risk factors for sustaining injuries among 95% (n = 138) of the participants. Participants' opinions on each risk factor were not consistent. An inadequately treated previous injury in the same body part (56.8%, n = 79) and fatigue, (43.6%, n = 61) were seen to be the strongest factors to increase the risk of injury. Only a small proportion of participants believed that specific playing positions increased the risk of injury 7.9% (n = 11). Increased joint mobility was not perceived to be a risk factor for injury by 53.2% (n = 74) of participants. A large proportion of participants (74.1%, n = 103) did not believe that menstruation could affect the risk of injury.

Figure 3-4 Participant opinions/beliefs about risk factors for sustaining soccer injuries

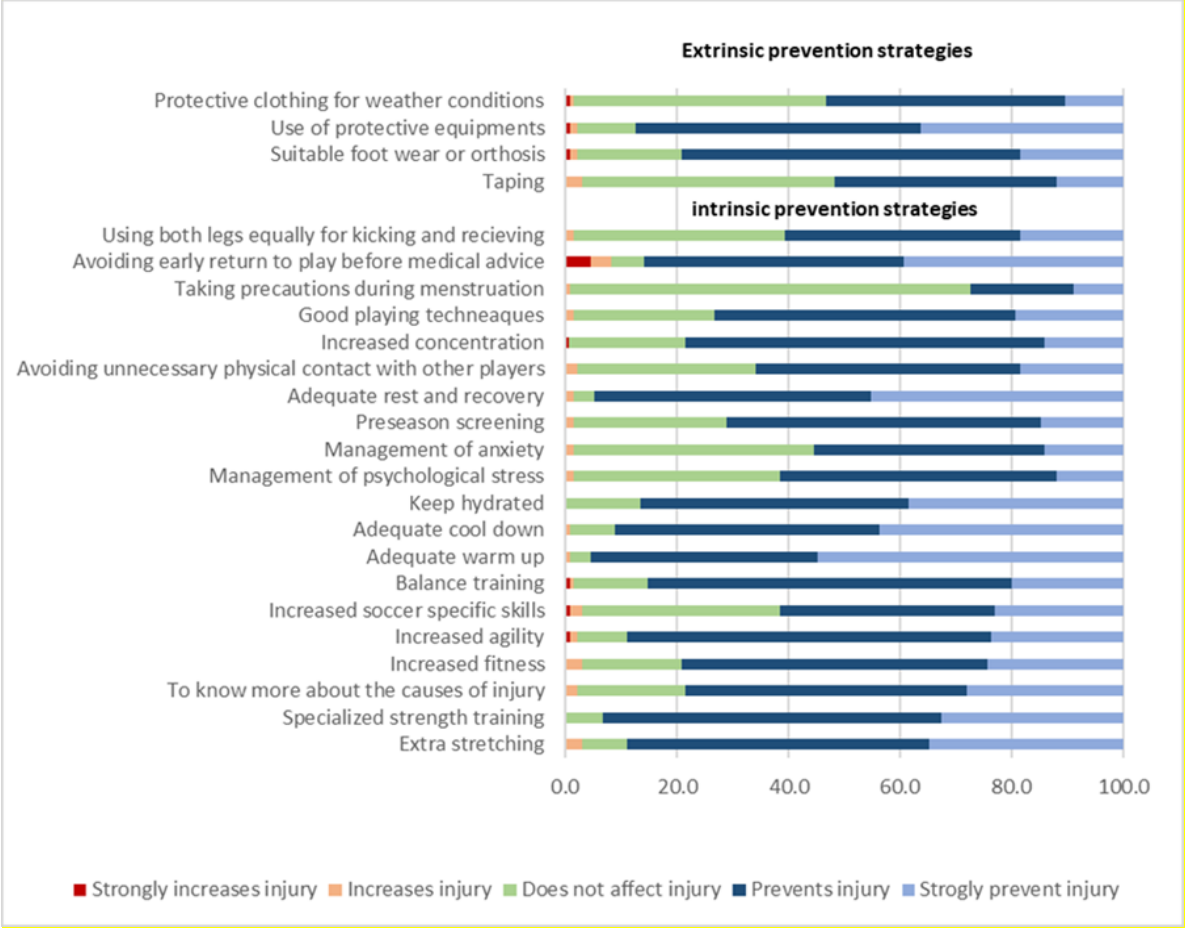
*Opinions about fitness deficit and playing surface were not reported by all participants

3.5.5 Education on injury prevention.

This part of the questionnaire was completed by 92% (n = 134) of participants. Half of the participants (50%, n = 67) had received no education on injury prevention; among those who had, the proportion who had received one-on-one session was the highest (46.2%, n = 31) when compared with other formats of education. The lowest proportion (10.4%, n = 7) of participants had received education during the same year of the survey (2019–2020), and 52.2% (n = 35) out of those who had received education, felt sufficiently informed about injury prevention.

Figure 3-5 illustrates opinions on prevention strategies for 93% (n = 135) of the participants. The prevention strategies believed to be the strongest were adequate warmup (54.8%, n = 74), and knowledge about the cause of injury (45.2%, n = 61). Most participants (71.9%, n = 97) did not believe that taking precautions while playing during menses would decrease the risk of injury.

Figure 3-5 Participant opinions/beliefs about prevention strategies of soccer injuries



3.5.6 Injured vs. uninjured

3.5.6.1 Demographics and risk factors

There were no significant differences between injured and uninjured participants for demographics (Table 3-7). The differences in the prevalence of risk factors between injured (57.2%, n = 83) and uninjured (42.8%, n = 62) participants and revealed significant differences only for SHC as a risk factor (Table 3-8). The mean SHC score (out of 13) was significantly higher among uninjured (5.4 ± 2.6) compared with injured (4.2 ± 3) participants (p = 0.014) (Table 3-8). Based on these scores, the two groups were in 'moderate' general health, with better health reported in the injured group. The subscales of SHC (Table 3-9) showed that uninjured participants reported higher scores (in percentages) than their injured peers in tiredness (9.1 vs. 8.4), anxiety (13.6 vs. 2.4), and poor sleep (6.1 vs. 4.8).

Table 3-7 Demographics of injured and uninjured amateur women soccer players participated in this study

Item (n)		Uninured	injured	Independent t-test p - value
Age: years		25.92 ± 8.08	25.17 ± 7.68	0.568
Age of puberty: years		24.30 ± 3.97	23.65 ± 4.03	0.339
BMI: kg/m^2		5.84±4.85	6.60 ± 5.23	0.385
Playing in more than one position	Yes	38.20 %, n = 21	61.80 %, n = 34	Chi-square P-value = 0.459
	No	44.40 %, n= 40	55.60 %, n = 50	

Table 3-8 Prevalence of risk factors among injured and uninjured participants and the association between risk factors and injury

	Category	Uninjured		Injured		Chi square P-value
		n	%*[1]	n	%*[2]	
FHI	No	45	46.4	52	53.6	0.209
	Yes	17	35.4	31	64.6	

JH	No	37	43.5	48	56.5	0.89
	Yes	25	42.4	34	57.6	
RPE	No activity	3	100.0	0	0.0	0.747
	Very easy	1	33.3	2	66.7	
	Easy	1	33.3	2	66.7	
	Comfortable	20	50.0	20	50.0	
	Somewhat difficult	15	40.5	22	59.5	
	Difficult	8	32.0	17	68.0	
	Hard	6	37.5	10	62.5	
	Very hard	5	55.6	4	44.4	
	Extremely hard	3	37.5	5	62.5	
Category of sleep problem	None	10	32	21	68	0.301
	Mild	30	47	34	53	
	Moderate	10	36	18	64	
	Severe	12	55	10	45	
Competition anxiety level	Low	12	37.5	20	62.5	0.772
	Average	37	44.6	46	55.4	
	High	13	44.8	16	55.2	
Playing position	Goalkeeper	10	58.80	7	41.2	0.174
	Defender	22	39.30	34	60.7	
	Attacker	13	59.10	9	40.9	
	Midfielder	11	34.40	21	65.60	
	Forward	13	59.10	9	40.90	
	Yes	40	44.40	50	55.60	

	Uninjured	Injured	Independent t-test value
Age: years (mean ± SD)	25.92 ± 8.08	25.17 ± 7.68	0.568
BMI: kg/m^2 (mean ± SD)	24.30 ± 3.97	23.65 ± 4.03	0.339
Play length	5.84±4.85	6.60±5.23	0.385
Score on SHC (mean ± SD)	5.4 ± 2.6	4.2 ± 3	0.014*
Soccer duration (mean ± SD) hours per week	2.2 ± 1	6.6 ± 5.2	0.45
Soccer frequency (mean ± SD session per week	2.8 ± 1.8	3.1 ± 1.7	0.43
TMD (mean ± SD)	103.1 ±19.0	99.8 ± 17.6	0.28

ASSQ, athletes' sleep screening questionnaire; BMI: Body Mass Index; FHI: Female Hormone Intake; RPE: players' rating of perceived exertion in soccer per week; SCAT, sport competition anxiety test; SHC, subjective health complaints; TMD, total mood disturbance; *[1]Percentage of uninjured participants for each category of the risk factor; *[2]Percentage of injured participants for each category of the risk factor.
*Significant value.

Table 3-9 Subscales of SHC of injured and uninjured amateur women soccer players participated in this study

Symptom		Not at all		A little		Some		Severe	
		n	%	n	%	n	%	n	%
Eczema	Uninjured	59	89.4	1	1.5	5	7.6	1	1.5
	Injured	74	89.2	2	2.4	5	6.0	2	2.4
Chest pain	Uninjured	54	81.8	8	12.1	4	6.1	0	0
	Injured	66	79.5	10	12.0	5	6.0	2	2.4
Breathing difficulties	Uninjured	40	60.6	22	33.3	4	6.1	0	0
	Injured	57	68.7	20	24.1	4	4.8	2	2.4
Heart burn	Uninjured	51	77.3	10	15.2	5	7.6	0	0
	Injured	68	81.9	9	10.8	5	6.0	1	1.2
Stomach discomfort	Uninjured	34	51.5	21	31.8	10	15.2	1	1.5
	Injured	49	59	22	26.5	12	14.5	0	0
Diarrhea	Uninjured	52	78.8	5	7.6	8	12.1	1	1.5
	Injured	71	85.5	9	10.8	3	3.6	0	0
Constipation	Uninjured	54	81.8	7	10.6	5	7.6	0	0
	Injured	64	77.1	14	16.9	5	6.0	0	0
Palpitation	Uninjured	43	65.2	14	21.2	8	12.1	1	1.5
	Injured	56	67.5	17	20.5	9	10.8	1	1.2
Tiredness	Uninjured	8	12.1	33	50.0	19	28.8	6	9.1
	Injured	13	15.7	34	41.0	29	34.9	7	8.4
Dizziness	Uninjured	46	69.7	16	24.2	4	6.1	0	0
	Injured	59	71.1	16	19.3	8	9.6	0	0
Anxiety	Uninjured	19	28.8	22	33.3	16	24.2	9	13.6
	Injured	38	45.8	26	31.3	17	20.5	2	2.4
Sadness/depression	Uninjured	36	54.5	22	33.3	7	10.6	1	1.5
	Injured	54	65.1	20	24.1	8	9.6	1	1.2
Sleep problems	Uninjured	33	50.0	20	30.3	9	13.6	4	6.1
	Injured	36	43.4	27	32.5	16	19.3	4	4.8

The mean SHC score, playing position, and female hormone intake (FHI) were significant (p-values < 0.2) at the univariate level and entered in a multivariate logistic regression model (Nagelkerke R^2 value of 0.166). Table 3-10 reports the OR of SHC to be 0.820,95% CI 0.710–0.947, p = 0.007, which indicates that an increased score on the SHC scale (i.e., decreased general health) significantly reduces the chance of injury compared with those who have no SHC. None of the remaining 10 risk factors (including joint hypermobility, and soccer exposure from our SR) was a significant predictor of injury in this cohort.

Table 3-4 multi-regression analysis of risk factors for sustaining soccer injuries

Factor	Level	Reference	Sig.	OR	95% CI
Female hormones intake	Yes	No	0.308	0.657	0.293–1.474
Playing position	Goalkeeper	Goalkeeper	0.052		
	Defender		0.099	3.449	0.791–15.051
	Attacker		0.187	2.28	0.669–7.764
	Midfielder		0.408	0.553	0.136–2.25
	Forward		0.247	2.144	0.59–7.792
Score on SHC	-	-	0.007	0.820	0.710–0.947

CI, confidence interval; OR, odds ratio; Sig., significance level.

3.5.6.2 Participants' opinions/beliefs about injury risk and prevention, and education

There was no significant difference in mean scores between the two groups for beliefs about risk factors (injured participants 72.09 ± 11.11, uninjured participants 74.09 ± 7.4, p = 0.23), or prevention strategies (injured participants 66.12 ± 14.66, uninjured participants 66.43 ± 12.73, p = 0.89). The difference in receiving education about injury prevention between injured (53.70%, n = 36) and uninjured participants (46.30%, n = 31) was not significant (p = 0.802).

3.6 Discussion

The aim of this study was to provide an overview of the risk factors for soccer injuries, injury profile, and players' opinions about risk factors and injury prevention strategies. This is, to our knowledge, the first study to explore these factors among amateur women soccer players in Ireland. The main findings of the present study are: 1) more than half of the participants play in more than one position; 2) there is a high number of injuries per player (1.06 injuries/player); 3) over half of the participants reported average anxiety; 4) injuries were higher among participants with better general health; 5) participants' knowledge about some risk factors including playing position, joint hypermobility; 6) playing during menses contradicts current evidence; and 7) half of the participants had not received any education on injury risk or prevention.

3.6.1 Demographics

Unalike elite level players who tend to have specific positions (Faude *et al.*, 2006), more than half of the participants play in more than one position, despite each position having special performance requirements (Onaka *et al*., 2017). Playing in more than one position without appropriate training could subject a player to increased risk of injury because of various loads, movement patterns, and combinations of predicted and unpredicted movements (Della Villa *et al.*, 2018). Possible reasons for this finding include the lower availability of substitute players for each position among amateur teams because of the lower financial support (Van Beijsterveldt *et al.*, 2015), or because of a lack of education among players and coaches concerning the importance of position-specific training. Therefore, comprehensive training on various positions among amateur teams with a low number of players is recommended.

3.6.2 Injury profile

The number of injuries per player among the studied group was higher when compared with their Spanish peers (0.08 injuries per player) over a 10-month season. A direct comparison of injuries per player in this study with other studies is limited by the differences in the length of the soccer season. This present study gathered information during the winter season to minimise the effect of weather changes on injury occurrence

(Waldén *et al.*, 2013). Recall bias (Zech and Wellmann, 2017) could have affected the accuracy of injury reporting in the present study. The high injury rate in the present study also may be partly explained by the increased tendency to fall when playing on a wet surface during winter (McGrath and Ozanne-Smith, 1997), the poor implementation of prevention programs (Gebert *et al*., 2019), lower quality of training among amateur players compared with their elite peers (Van Beijsterveldt *et al.*, 2015), and decreased financial support for rehabilitation provided to amateur teams (Van Beijsterveldt *et al.*, 2015) leading to limited access or lower quality healthcare (Hägglund *et al*., 2016). However, information about health care provision to Irish amateur women soccer players is lacking and warrants further exploration.

Pre-season screening programs are recommended to identify players at risk of injury (Alahmad *et al*., 2020). In addition, compliance with comprehensive injury prevention programs such as FIFA 11+ also has been found to reduce the risk of soccer injuries by 35% (Al Attar *et al*., 2018).

3.6.3 Prevalence of risk factors

SCAT scores reveal that over half of the participants reported 'average anxiety' levels. Competition or sport-related anxiety interrupts players' concentration, thus increasing the chance of injury (Sajedi and Kirkbir, 2020). Sport-related anxiety is a modifiable risk factor (Theisen *et al.*, 2014) associated with injury among amateur soccer players (Jansen *et al*., 2019; Sajedi and Kirkbir, 2020). There were no significant differences in SCAT scores between injured and uninjured groups in the present study. Results for anxiety in the present study are also in accordance with Indian women collegiate soccer players (Singh and Punia, 2019) but lower than elite women hockey players, as 66.6% reported 'high competition anxiety' (Rasyid *et al*., 2019). Variation in results could be explained by differences between games and athletic levels, as the SCAT scores are higher among elite athletes (Lorenz *et al*., 2013). These findings suggest the application of programs to increase self-confidence, physical performance (Sajedi and Kirkbir, 2020), and to develop coping strategies are warranted.

Subscale analysis of risk factors revealed an increased prevalence of tiredness compared with other SHC's, and fatigue compared with other negative subscales on POMS. Fatigue

is a modifiable risk factor of soccer injury (Theisen *et al.*, 2014). It decreases players' psychological and physiological response to sport load, because of decreased concentration, higher perception of training load, and increased muscle damage (Jones *et al*., 2017). To decrease the effect of fatigue; differences between players such as the fitness level, age, or psychological state should be considered when prescribing training load (Soligard *et al*., 2016). Monitoring the training load of players using internal (e.g., RPE) and external (e.g., frequency and duration) load measures while considering the rate of load changes is also called for (Soligard *et al*., 2016; Gabbett, 2016). Implementing these recommendations could be achieved through dedicated education and training of amateur teams' coaches.

3.6.4 Participants' opinions/beliefs about injury risk and prevention

A systematic review that identified risk factors for injury among elite women soccer players (Alahmad *et al*., 2020) found that inadequately treated previous injury, increased exposure, unequal muscle strength in the lower limbs, decreased balance, and increased BMI can increase the risk of injury. Consistent with evidence for women players, the participants in this present study identified the aforementioned risk factors to increase the risk of injury. However, in contrast to their male peers (Zech and Wellmann, 2017), a large proportion of participants did not perceive the playing position to be a cause of injury. Their opinion contradicted evidence that suggested a higher risk of injury existed for players that were closer to the goal because of the increased aggressiveness of play and level of contact between players (Alahmad *et al*., 2020). The player's beliefs that 'fatigue' was a strong risk factor, is consistent with the beliefs of elite men soccer players (McCall *et al.*, 2014) and consistent with evidence among sporting populations (Jones *et al*., 2017). Similar to other athletic groups (Van Hooren and Peake, 2018; Yanaoka *et al*., 2018; Van den Tillaar *et al*., 2019), a large percentage of participants perceived warm-up and adequate rest and recovery to be strong injury prevention strategies, and for the incorrect application of warm-up and cool down to increase the risk of injury.

More than half of the participants did not believe joint hypermobility increased the risk of injury. A systematic review with meta-analysis (level 1 evidence on the Oxford Centre of Evidence-Based Medicine (OCEBM) scale) reported a significant increase in the risk of

lower-limb joint injury among participants with joint hypermobility during sport because of a lack of sufficient restraints of excessive movements in the affected joints (Pacey *et al*., 2010). Players with joint hypermobility are advised to increase their muscle strength to increase joint stability and decrease the risk of injury (Chidi-Ogbolu and Baar, 2019).

Most participants also reported that playing during menstruation did not increase the risk of soccer injuries. Hormonal fluctuations during the menstrual cycle can alter the structure and function of musculoskeletal tissues (e.g., muscles, ligaments, tendons) (Chidi-Ogbolu and Baar, 2019). An English study conducted over a four-year period (level 2 evidence on the OCEBM scale) found that muscle and tendon injuries to be almost doubled among women football players with increased progesterone levels during their early follicular phase of the menstrual cycle (Martin *et al.*, 2021). A prospective study (level 2 evidence on the OCEBM scale) also reported that increased serum relaxin concentrations during menses increased the risk of ACL injury by four times among elite female athletes (Dragoo *et al*., 2011). However, currently, there is insufficient evidence to support any association between menses with injury among amateur women soccer players, and further investigation is warranted. These findings show that the participants' opinions regarding injury risk and prevention both concurred and contradicted with existing the evidence. Inadequate knowledge about injury risk and prevention could influence a player's preventive behaviour and therefore increasing the risk of injury (Ajzen *et al*., 2011). Future qualitative investigations are recommended to improve understanding of this field.

3.6.5 Education on injury prevention

Half of the participants had received no education on injury prevention. Those who did were educated through one-on-one sessions. A general lack of knowledge may have contributed to the increased injury rate reported in the present study. Hence, preventive training and collaborative educational programs between sport and medical staff are recommended, and barriers to amateur players' education must be addressed.

3.6.6 Injured vs. uninjured (prevalence of risk factors)

Lower scores on the SHC reflect better general health (Tschudi-Madsen *et al.*, 2011). The total mean score of SHC was significantly lower (better general health state) among injured participants, suggesting the chance of sustaining a soccer injury is higher with better general health state. A direct comparison of these findings with other studies reporting an association between SHC and injuries (Van Tonder *et al*., 2016; Sullivan *et al.*, 2019) is limited by the differences in aims and methodologies. Possible explanations are that healthier participants tend to be more active and faster in the field, and therefore are more likely to sustain more injuries. Also, relatively healthy participants are subjected to higher soccer exposure (mean soccer duration = 6.6 ± 5.2 hours per week, mean soccer frequency = 3.1 ± 1.7 sessions per week) compared with their uninjured counterparts (mean soccer duration = 2.2 ± 1 hours per week, mean soccer frequency = 2.8 ± 1.8 sessions per week). Furthermore, the length of time playing soccer (in years) was higher among injured (6.60 ± 5.23) compared to uninjured participants (5.84 ± 4.85).

Higher soccer exposure is an established injury risk factor in women's soccer (Alahmad *et al.*, 2020). Furthermore, poor general health may alter a player's response to training load (Watson *et al.*, 2016), explaining the lower soccer exposure among uninjured participants. In addition, poor general health can have a negative impact on players' performance (Harada *et al.*, 2016). Participants with reduced general health (uninjured participants in the current study) may be slower in the field. This is supported by literature that has reported that low playing speed and the taking of more precautions during a game among players with poor general health reduces the likelihood of injuries (Mayer and Thiel, 2014).

Tiredness (fatigue), anxiety, and poor sleep are established risk factors for soccer injuries (Faude *et al.*, 2006; Ivarsson *et al*., 2013; Silva *et al.*, 2020). However, unexpectedly, in the present study, uninjured participants reported higher scores (in percentages) than their injured peers these risk factors; tiredness (9.1 vs. 8.4), anxiety (13.6 vs. 2.4), and poor sleep (6.1 vs. 4.8). This could be explained by using one definition of injuries (based on days lost), which may confound the findings and increased the likelihood of missing data about non-time loss injuries among participants with poor health.

Based on these findings, two categories of recommendations are suggested. Interventions to manage the training load and reduce the onset of fatigue are recommended for (injured) healthier participants to reduce soccer injuries (Soligard *et al.*, 2016). These interventions may include monitoring the training load by coaches and increasing the players' strength and fitness (Soligard *et al.*, 2016). Uninjured participants who report higher scores of tiredness, anxiety, and poor sleep are advised to implement strategies to manage these health complaints. These strategies should be guided by education on how to achieve adequate recovery, sleep hygiene, and how to manage anxiety.

This present study has revealed that risk factors among Irish amateur women soccer players differ from women soccer players at different levels and in different countries, perhaps because of differences (Eirale *et al*., 2017) in playing style (Waldén *et al*., 2013), physical capacity, training characteristics (Lorenz *et al*., 2013), and financial support (Gebert *et al*., 2018). There was no significant difference between mean scores for beliefs about risk factors, prevention strategies, or receiving education among injured and uninjured participants. The knowledge that has been developed based on inaccurate information about injury risk and prevention cannot be used to predict the players' preventive behaviour (Ajzen *et al*., 2011). Improving the level of players' knowledge about injury risk and prevention may increase their uptake of prevention measures, therefore, decreasing injuries (McKay *et al*., 2014).

3.6.7 Limitations

This research provides preliminary findings about the injury profile and prevalence of risk factors among Irish amateur women soccer players during the preceding winter season. Research findings (the first among this cohort) could inform future prospective (Talari and Goyal, 2020) or qualitative studies, and be used for comparison between different countries or seasons of the year. This research is limited by its retrospective design, which may increase the risk of recall bias (Althubaiti, 2016). The relatively small sample size, and with over half of the participants being from a single Irish province, affect the ability to generalise the findings.

A lack of consideration of the potential impact of work commitments on injury occurrence also represents a possible limitation of this research. Data regarding playing with pain or

injury were not collected, thereby increasing the likelihood of missing non-time loss injuries. The injury incidence per 1000 hours of soccer exposure could not be determined based on collected injury information. Additionally, we sought the opinions of participants regarding additional risk factors which were not included in section one of the survey (prevalence of risk factors). These additional risk factors were added for a broader exploration of participants' knowledge about injury causes to inform future educational programs on injury prevention. However, the prevalence of these factors was not explored in section one, as they are difficult to assess through self-reporting.

3.7 Conclusion

This study reveals that fatigue was the highest reported SHC, the highest negative subscale of POMS, and the highest perceived risk factor for injury. To adequately address this, further load-management studies are required. More than half of the participants played in different positions, and the participants' opinions on risk factors and preventive measures both concurred and contradicted existing and current evidence. These findings highlight the need to facilitate access to education on injury risk and prevention among amateur women soccer players. Additionally, qualitative studies are required to further understand the causes of fatigue and explore players' beliefs, and the implementation of prevention strategies.

3.8 Highlights

- Causes of fatigue among amateur women soccer players must be explored, with an emphasis on the impact of gender and play level.
- Identification of potential barriers and facilitators of players' education about injury prevention and evidence-based preventive measures must be identified.
- Strategies to encourage translation of knowledge (about risk factors and prevention measures of soccer injuries) to real-life soccer practice should be encouraged to decrease the risk of injury among amateur women soccer players. This means reducing barriers and providing the facilitators of players' preventive behaviour. For example, players who see warm up as a prevention measure require

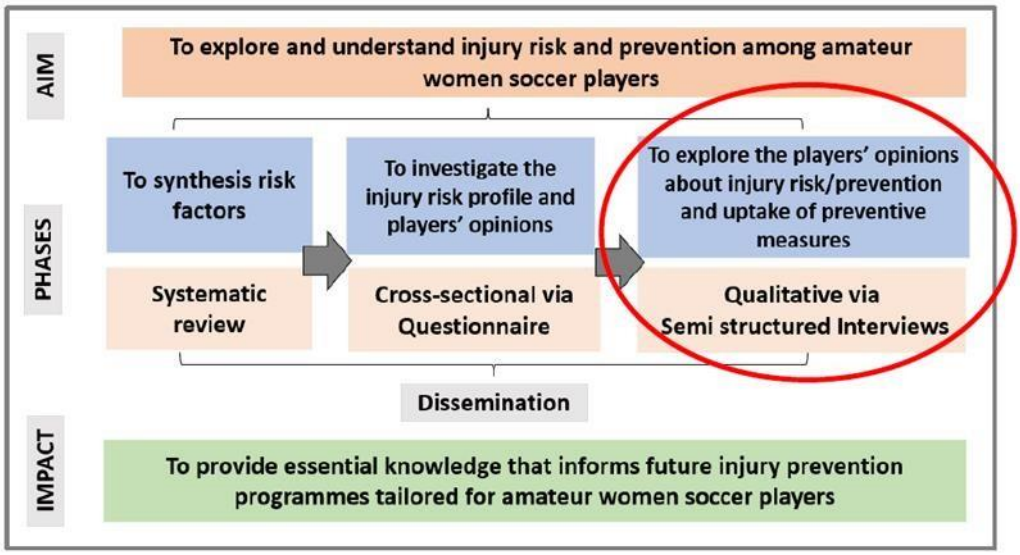
strategies to encourage implementing adequate warm up before soccer game/practice such as knowledge on the variety of warm up methods and how to achieve adequate warm up.

3.9 Epilogue

The findings from this research (the first among this cohort) may be used to inform future prospective or qualitative studies, and for comparisons between different countries or seasons of the year. Research results inform the aim and design of the next chapter (Qualitative study) and add valuable information to the literature on amateur women's soccer.

The article based on this cross-sectional study was published in the peer-reviewed journal *Physical Therapy in Sport* (Alahmad *et al.*, 2021).

Chapter 4 The qualitative study



The corresponding research stage

Injury risk and prevention strategies among Saudi and Irish amateur women soccer players—a qualitative study

Author contributions:

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	Study design	Collected/ conceived data	Analysis and interpretation	Drafted manuscript	Critical manuscript review/ approval for publication
Tahani Alahmad	Yes	Yes	Yes	Yes	Yes
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Audrey Tierney	Yes	No	Yes	No	Yes
Pauline Boland	Yes	No	Yes	No	Yes

4.1 Prologue

According to the Translating Research into Injury Prevention Practice (TRIPP) framework, researchers need to understand players' behaviour when determining how and why interventions are implemented (stage five). Furthermore, they need to identify the modifications of prevention strategies required to make them more applicable, and to evaluate the real-life implementation of these interventions (Finch, 2006). This chapter addresses the third objective of this project, which was formulated based on the TRIPP model.

The design and interview script for this research were informed by the findings of the previous two chapters. The aim was to explore players' knowledge and behaviour to inform future educational and training programmes. To achieve this aim, thematic analysis (Braun and Clarke, 2020) was used. This research is novel in its subject, the cross-cultural comparison between Saudi and Irish women soccer players.

Saudi Arabian amateur women soccer players were selected to be compared with their Irish peers because the first author is Saudi and has travelled back to Saudi Arabia during the COVID crisis in 2020. Women's soccer has been only recently established in Saudi Arabia, and very little research has examined it. Selecting Saudi women players for comparison with Irish players gave the author an opportunity to develop recommendations to ensure the safety of soccer practice for these players. Also, an international perspective—a comparison of Middle Eastern Muslim and European, predominantly non-Muslim (Christian) women players—enabled the author to develop recommendations more appropriate for real-world application for soccer practice among amateur women. In addition, the religious and geographic divide between the two cultures provided a better understanding of the effect that culture might have (Al-Bannay *et al.*, 2014) on the subject of injury prevention perception and experiences of amateur women players.

Findings of this study could be used to inform the design of future injury-prevention educational programmes aimed at better implementing evidence-based measures among Irish and Saudi amateur women soccer players.

4.2 Abstract

Objective: This qualitative study aimed to explore how Saudi and Irish amateur women soccer players perceive soccer-related injury risk and prevention, including barriers to and facilitators of the implementation of prevention strategies.

Methods: Online interviews were conducted with 36 amateur women soccer players (20 Saudi and 16 Irish) of 18 years and older.

Results: Findings were analysed using Reflexive Thematic Analysis. Three main themes were identified: 1) "we don't have enough knowledge about injury prevention" 2) implementing injury prevention measures varies across participants and teams, and 3) "we love the game … but we are undervalued." The diverse biopsychosocial characteristics of the participants are characterised by the nuanced data found.

Conclusion: Tailored educational programmes for women, their coaches, and parents of younger players, as well as provision of the required support for amateur teams, are all recommended to encourage participation and implementation of evidence-based injury prevention strategies, taking player's biopsychosocial characteristics into account.

Keywords: injury prevention, amateur soccer, women, perception, behaviour

4.3 Introduction

Over the past decade, a reduction in gender discrimination and increased support from football federations have led to a global increase in female participation in soccer (Ruiz Esteban *et al.*, 2020) across all levels of play (FIFA, 2019). However, this increased participation in a contact sport has increased the risk of injury (Saeidi, 2016). Amateur women involved in soccer play for fun and fitness (Piermattéo *et al.*, 2020), however, they sustained higher injuries per 1000 hours of soccer exposure (0.7–20.3 vs. 3.19–8.40) when compared with their elite peers (Klein *et al*., 2018). Despite this, research exploring injury prevention in amateur women's soccer is uncommon (Al Attar *et al.*, 2016).

Soccer injury can negatively impact affected players, teams, and leagues of all levels (Gebert *et al.*, 2018), including outcomes for players such as fear of movement, re-injury anxiety, negative mood (Tripp *et al.*, 2011), quitting sport early (Sadigursky *et al.*, 2017), and financial burden of treatment and rehabilitation (Gebert *et al.*, 2018). To decrease the incidence of injuries, football federations are encouraging the implementation of injury prevention strategies among soccer players at all levels (Bisciotti *et al.*, 2019).

Strategies such as adequate warm-up and cool-down periods have been commonly used to prevent soccer injuries (Berkes *et al*., 2006). In addition, adequate recovery (a multilayered process in which the body restores its balance at all levels (e.g., physiological, biological, psychological) after having been disturbed by some internal or external factor such as sport-induced fatigue (Kellmann *et al.*, 2018)) has been commonly used to reduce soccer injuries (Berkes *et al*., 2006). The level of players' adherence to the preventive measures (preventive behaviour) influences the effectiveness of these evidence-based strategies (Wiese-Bjornstal, 2010). Thus, a nuanced understanding of how women soccer players perceive and manage injury risk is required, and the biopsychosocial factors influencing preventive behaviours should be identified (Duminica, 2020) and addressed (Finch, 2006).

Biopsychosocial factors are the individual's characteristics, including biological factors such as age and physical abilities, psychological or behavioural factors such as lifestyles and health beliefs, and social factors such as culture, environment, and social support (Hatala, 2012). These individual characteristics can affect human behaviours (Hatala,

2012). Culture is an individual characteristic that affects human behaviour. It represents the beliefs, norms, behaviours, and values that characterise a group of people, and it is shaped by religion, environment, and level of education (Al-Shahri, 2002). Culture involves power and privilege, which means that one group (e.g., men) have more power and advantage than the other (e.g., women) (Gill, 2017). These differences result in female athletes receiving less support and being less-appreciated (Abbasi, 2014).

Variation in culture, habit and religious practice may influence sports injury risk, and players' preventive behaviours and the incidence of injuries (Eirale *et al.*, 2017). For instance, the incidence of soccer injuries during Ramadan fasting differed among male soccer players from different cultures (Eirale *et al.*, 2017). Cross-cultural studies can provide a deeper understanding of how cultural differences moderate human perception and behaviours (Berry *et al.*, 2011). To the authors' knowledge, there are no studies exploring injury prevention in the context of biopsychosocial factors among women soccer players.

Players' knowledge of injury risk and prevention can influence their preventive behaviours (Finch, 2006). According to the Theory of Planned Behaviour (TPB), lack of knowledge about injury risk and prevention can inhibit a player's preventive behaviours (Ajzen *et al*., 2011), resulting in an increased risk of injury. This may explain the findings of a recent cross-sectional study, which identified a higher number of injuries per player with a lack of knowledge about the effect of some risk factors (i.e., playing position and joint hypermobility) among amateur women soccer players (Alahmad *et al*., 2021).
However, there remains no clear understanding of the players' level of knowledge and real-life preventive behaviours among amateur women.

Despite qualitative methods providing information about human behaviours by exploring the circumstances and beliefs for various activities (Bolling *et al*., 2020), there are limited qualitative studies in amateur women's soccer. One such study among amateur women soccer players explored how playing soccer affected their leisure, work, and family identities (Ledlin, 2007). It was reported that while players valued the sense of team and confidence playing gave them, they felt constrained by organisational aspects which could priorities skill level over the more social aspects. To the author's knowledge, no

qualitative study has explored players' experiences on injury risk and prevention in amateur women's soccer.

The primary aim of this research is to develop an understanding of amateur women soccer players' preventive behaviours, and what factors influenced these behaviours. This information can be used to better-inform strategies to support women soccer players to engage in injury prevention. A second aim is to compare the experiences on injury risk and prevention of amateur women players from Saudi Arabia (a Middle Eastern Muslim country) and Ireland (a European predominantly non-Muslim country) to understand how cultural differences may affect player's preventive behaviours. Saudi Arabian amateur women soccer players were selected to be compared with their Irish peers because the first author was from Saudi Arabia (see the chapter's prologue for further justification of selecting Saudi amateur women).

4.4 Methods

4.4.1 Design

A qualitative interpretative research design was followed, using Reflexive Thematic Analysis (RTA), to analyse interviews gathered from semi-structured online methods.
Ethical approval was granted by relevant Irish and Saudi Research Ethics Committees [2020_06_18_EHS], [2020-12-24]. The constructivist paradigm informed the overall study (Wisdom and Creswell, 2013), which encouraged us as researchers to recognise during analysis that one's understanding of a concept (like injury prevention) is embedded within one's socio-cultural environment (Kim, 2001).

4.4.2 Research team

The first author TA is bilingual, from a Saudi background, has lived in Ireland for three years (See the self-reflection for more details about the positionality of the first author). Other members of the team were AT, PB and AC, all of whom are health professionals from a white Irish background. PB is an expert in qualitative research while AC and AT are experienced in mixed methodologies.

4.4.3 Participants

Women players aged 18 years and over who were currently playing in Irish and Saudi amateur soccer teams, were invited to participate in this study.

4.4.4 Procedure

4.4.4.1 Piloting

To ensure clarity of questions in the interview guide, and interview technique refinement for both proposed groups (Majid *et al.*, 2017), the first author (TA), conducted pilot interviews with seven volunteers: from Saudi Arabia (n = 3) and Ireland (n = 4). Piloting identified the need for the interviewer to use more and a greater variety of prompts to gain sufficiently in-depth information from participants about the phenomena of interest.

4.4.4.2 Recruitment

The first author (TA) contacted gatekeepers (team coach or team manager for the Irish group, and coordinators from the Football Federation for the Saudi group) to explain the study and request the distribution of information to eligible players. Because of an initial lack of responses from Irish players, an incentive was offered to encourage participation, where participants could enter a draw for a €150 gift card. The incentive was ethically approved and included to increase recruitment to have a sufficient breadth and richness of data. Snowballing was also used to recruit more participants from the Irish teams.

The first author conducted online audio (no video calls) semi-structured interviews via Microsoft Teams or Zoom and an interview guide (Gratton, 2014), and probing questions to gain more in-depth information (Ivarsson *et al.*, 2021). The interview guide included three sections: 1) perceived risk factors for soccer injuries, 2) reported injury prevention measures and how are they implemented, and 3) barriers and facilitators to implementing injury-prevention measures. (See supplementary 2 for the interview guide details.)

In total, 36 participants were interviewed (20 Saudi, 16 Irish); the average interview duration was 43.8 minutes, with the duration of any interview ranging 24–60 minutes.

The first author prepared the data, transcribing the Irish group's interviews verbatim, then sending a transcript copy to each participant to read and approve the text (Al Dandan *et al.*, 2022). TA transcribed the Saudi group's interviews verbatim, first in Arabic, then translated the entire text into English, then reverse-translated the entire text back into Arabic to ensure equivalence of meanings between the source and target texts, a recognised approach (Choi *et al.*, 2012). During the interview, the interviewer recounted the main points (concepts and ideas) that she understood from the participant's responses to ensure that she had captured the meanings intended by the interviewee.

Each participant's identity was anonymised, and represented in data analysis by her nationality, interview number, and age (e.g., Irish 33, 55 years). Transcription was conducted immediately after each interview to inform subsequent interviews (e.g., some minor changes included re-ordering of the questions or an increase in probing queries).

4.4.5 Data analysis

Data were analysed using Reflexive Thematic Analysis (RTA) approach (Braun and Clarke, 2020), which enables production of a rich, detailed description of a phenomenon and the factors that influence it. This method allows researchers to describe the experiences of a group, and to highlight similarities and differences across participant accounts (Braun and Clarke, 2020); existing theories also can be incorporated into analysis using this approach. Because one of the aims of this study was to explore participants' knowledge about injury prevention, the theory of planned behaviour (Ajzen *et al.*, 2011) underpinned the rationale for the study, and was used to help support the interpretation of the findings—an approach that is consistent with creative use of RTA (Braun and Clarke, 2020).

TA completed all six stages of RTA developed by Braun and Clarke (2020). Stage one entailed deep engagement with the data (conducting the interviews, listening to the recordings, transcription of interviews, translation and back translation of the Arabic interviews into English). Stage two consisted of line-by-line coding of all transcripts, ensuring that the codes represented the underlying text, with each member of the research team independently coding two transcripts from each group, to discuss what they recognised as principal codes at this point. In stage three, codes were reviewed to generate

candidate themes, reflecting consistently on the research question and the unique lens of each person involved in the analysis, to develop a thematic map. Data analysis in stages 1, 2, and 3 was mainly inductive (codes were data driven). In stages 4, 5, and 6 a deductive approach was undertaken (Byrne, 2021), in which the theory of planned behaviour was used to ensure that the identified themes were meaningful to the research aims. In stage four, candidate themes were evaluated in relation to the codes, original data and research aims, and the theory of planned behaviour, to ensure that the themes were related but distinct from one another. Stage five involved refining the themes by writing a clear definition for each, and in stage six the themes were constantly reviewed during the writing of the final report, which is consistent with this approach to analysis (Nowell *et al.*, 2017). NVivo 12 pro software was used to import transcript, organise, store, and retrieve data for analysis.

4.4.6 Rigor

Several strategies recommended by Shenton (2004) were used to ensure methodological rigor. For credibility, steps of analysis were continually recorded in a reflective journal throughout the research and shared with the research team. For reflexivity, TA's beliefs, interest in injury prevention, the importance of client education, and using the biopsychosocial model in prevention and intervention, as well as her previous clinical and academic physiotherapy experience, were all noted in a self-reflection journal. For confirmability the reflective journal and self-reflection of TA, and the continuous discussions between the research team supported an iterative approach to analysis and interpretation. For dependability two randomly selected transcripts from both groups were independently coded by each member of the research team, with the main codes discussed in a consensus meeting (peer-debriefing). In addition, Braun and Clarke's 15Points Checklist of Criteria for Good Thematic Analysis (Braun and Clarke, 2006) was used during planning and reporting of findings.

4.5 Results

Study participants comprised 36 women of mean age 27.8 ± 8.2 years, with a wider age range among Irish (19–55 years) than Saudi (20–37 years) participants. Participants'

demographic characteristics and self-reported injuries are detailed in Table 4-1 (overpage).

Three key themes were identified: 1) “we don’t have enough knowledge about injury prevention,” 2) implementing injury prevention measures varies across players and teams, and 3) “we love the game…but we are undervalued.” Each key theme had two subthemes. Biopsychosocial characteristics such as beliefs, culture, age and a previous injury experience influenced (moderated) the participants’ perceptions of the causes of injury and measures to prevent injury, as well as their implementation of injury-prevention measures as illustrated in Figure 4-1. These characteristics were interlinked, for example, a player’s beliefs were in turn influenced by age and culture. Participants’ implementation of prevention strategies was sometimes referred to as “preventive behaviour.”

Similarities in the experiences regarding injury prevention were found between the majority of Saudi and Irish participants across the three themes. Differences between the two groups and the effect of the biopsychosocial characteristics (moderators) were highlighted when found within each theme.

Similarities were also found during analysis between participants from both groups in the same age group (the age groups identified were 18–19 years, 20–30 years, > 30–40 years, and > 40 years). These age-related similarities could relate to their beliefs, physical abilities, play style, soccer experience, and stage of life, including commitments to family and work. Most importantly, similarities were found in the participants’ perceptions and experiences in injury risk and prevention in each of these age groups.

Table 4-1 Participant demographics (n = 36)

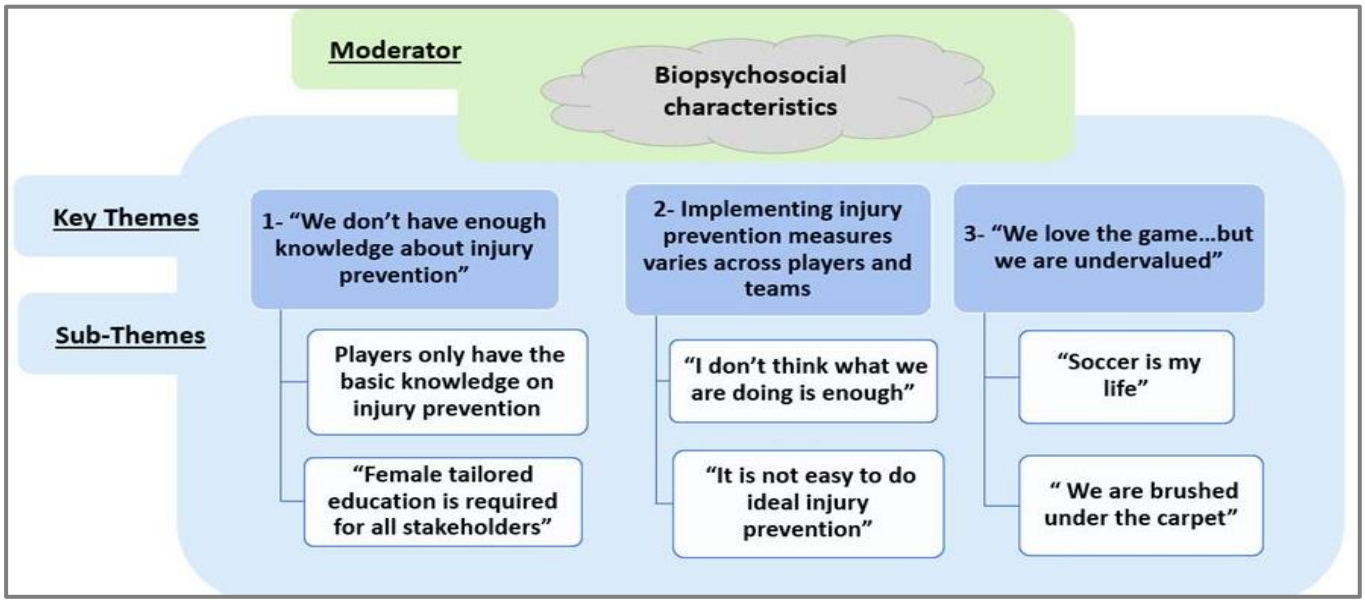
Participant	Age year	Playing position	Injured in the last playing season	Injury location	Injury type	Severity based on days lost
Saudi group						
Player 1	24	Midfielder	No	N/A	N/A	N/A
Player 2	25	Goalkeeper	Yes	Little finger	Fracture	Severe
Player 3	30	Attacker	No	N/A	N/A	N/A
Player 4	26	Attacker	Yes	Ankle	Sprain	Moderate
Player 5	24	Defender	Yes	Knee	Contusion	Severe
Player 6	26	No specific position	Yes	Ankle	Sprain	Moderate
Player 7	26	Defender	No	N/A	N/A	N/A
Player 8	24	Goalkeeper	No	N/A	N/A	N/A
Player 9	25	Midfielder	Yes	Ankle	Sprain	Moderate
Player 10	24	Attacker	No	N/A	N/A	N/A
Player 11	30	Attacker	No	N/A	N/A	N/A
Player 12	21	Attacker	Yes	Ankle	Sprain	Moderate
Player 13	20	Attacker	Yes	Ankle	Sprain	Mild
Player 14	20	Attacker	No	N/A	N/A	N/A
Player 15	24	Goalkeeper	Yes	Middle finger	Fracture	Severe
Player 16	23	Attacker	Yes	Ankle	Sprain	Severe
Player 17	37	Goalkeeper	Yes	knee	Contusion	Severe

Player 18	32	Attacker	Yes	Ankle	Sprain	Severe
Player 19	28	Midfielder	Yes	Knee	Torn ligament	Severe
Player 20	29	Attacker	No	N/A	N/A	N/A
Irish group						
Player 21	21	Midfielder/defender	No	N/A	N/A	N/A
Player 22	19	Goalkeeper	Yes	Head	Concussion	Severe
				Back	Spinal cord	Moderate
				Face	Slit	Minimal
Player 23	21	Goalkeeper	Yes	Knee	Unclear	Severe
Player 24	21	Attacker	Yes	Knee	Meniscal tear	Severe
Player 25	30	Midfielder/attacker	Yes	Knee	Torn ligament	Severe
Player 26	43	Defender	No	N/A	N/A	N/A
Player 27	29	Midfielder	No	N/A	N/A	N/A
Player 28	46	Defender	No	N/A	N/A	N/A
Player 29	41	Forward	Yes	Rib	Crack	Severe
Player 30	28	Defender	Yes	Thigh	Pulled ligament	Moderate
				Knee	Pulled muscle	
				Ankle	Sprain	
				Foot	Bruise	
Player 31	24	Midfielder/defender	Yes	Toe	Fracture	Severe

				Knee	popped	
Player 32	21	Midfielder	No	N/A	N/A	N/A
Player 33	55	Defender	Yes	Knee	Torn ligament	Severe
Player 34	38	Attacker	No	N/A	N/A	N/A
Player 35	20	Defender	No	N/A	N/A	N/A
Player 36	24	Attacker	No	N/A	N/A	N/A

N/A: not applicable

Figure 4-1 Summary of findings



4.5.1 Theme 1: "We don't have enough knowledge about injury prevention"

In this theme, the participants' described their knowledge about injury risk and prevention, highlighting their need for detailed education tailored for female players to promote safe playing practice. The effects of moderators on the participants' knowledge about injury risk and prevention were explained in this theme as well.

4.5.1.1 Subtheme 1: Players only have the basic knowledge on injury prevention

In this subtheme, the participants discussed their knowledge on injury risk which they perceived as "not enough" to inform adequate preventive behaviour: "*I don't feel I know enough to do more*" (Irish 28, 46 years). Teams' coaches were the main source of participants' knowledge about injury risk and prevention. Other less-common sources included physiotherapists, websites, or peers who had previously experienced a similar injury. Formal education on sport injury prevention (i.e., in the college of Sport or Medicine) was also reported among participants who discussed detailed knowledge about the effect of risk factors and preventive measures from both groups. However, seeking knowledge about prevention and management of injuries was reported more often among the Saudi participants: "*In the beginning I was searching Google and looking for information, trying to find the maximum amount of information that will help me to avoid injury and how to manage my injury, if I have one*" (Saudi 3, 30 years).

Participants from both groups described different former knowledge about soccer skills. In the Irish group, knowledge developed earlier because some Irish participants played in girls' teams or grew up with a soccer-playing brother. In contrast, Saudi participants learned soccer skills later when they joined a team.

If a player had sustained a previous injury, this could influence their knowledge on injury risk and prevention and increased the perceived susceptibility of injuries and perception of risk factors among some participants. The participants' perceived susceptibility of injuries was also moderated by their age. Participants over 30 years believed that they were at higher risk of injury as they developed fatigue earlier than their younger peers. In contrast, older participants perceived that their younger peers (18–19 years of age) were less likely to expect injuries or recognise their consequences: *"the younger girls think 'I won't get hurt'"* (Irish 29, 41 years).

Participants cited many internal and external causes of soccer injuries. Examples included non-modifiable factors such as a previous injury and older player's age, and modifiable factors such as poor sleep and diet, fatigue, inadequate implementation of injury prevention measures (e.g., warm-up), and less experience playing soccer: *"if you are*

newer to the sport of soccer and you're not properly trained. For whatever reason, you would definitely be more prone to an injury" (Irish 27, 29 years). Saudi participants reported young players [with lower playing skills] appeared to be more injury-prone and possibly causing a risk to others in the field (mostly through an aggressive playstyle).

The participants' environment influenced their perception of some risk factors. The nature of the playing surface, such as holes in a grass field, was reported to be an external cause of injury by both groups. However, only Irish participants mentioned that weather changes (i.e., a muddy field after rain) could influence their injury risk.

4.5.1.2 Subtheme 2: Female tailored education is required for all stakeholders

In this subtheme, participants clarified their need for education on injury risk and prevention, suggesting essential topics and methods of delivering future educational programmes. All participants recommended that formal education on injury risk, management, and prevention should be enhanced to reduce injuries: *"Education and knowledge will encourage the correct and safe practice"* (Saudi 18, 32 years). They insisted that education should be delivered for all associated with soccer*: "Coaches' education, parents, players. All three of them are so important"* (Irish 23, 21 years). The participants highlighted the importance of female-tailored education about injury risk and prevention: *"The nature of women and their life routine is different from that of men; also, their bodies and hormones are different. Education providers should consider these differences"* (Saudi 15, 24 years). Priorities for education included: causes of injury, risk factors, and how the female player's body functions. The participants recommended providing education on injury prevention from the very start of playing soccer, and to include campaigns and interactive education with qualified educators. Unalike their Irish peers, Saudi participants cited the basics of soccer skills as a part of their future educational programmes.

4.5.2 Theme 2: Implementing injury-prevention measures varies across players and teams

In this theme, the participants described how they were implementing injury-prevention measures at both individual and team levels. They explained the factors limiting their implementation of preventive measures and suggested several facilitators for their preventive behaviours. The effects of the biopsychosocial moderators such as age and culture on participants' preventive behaviours were also highlighted.

4.5.2.1 Subtheme 1: "I don't think what we are doing is enough"

In this sub-theme, the participants mentioned that injury is a part of playing soccer and explained that most of their current methods of implementation were inadequate.

Participants generally believed that injury was an inevitable part of playing soccer. However, their beliefs about soccer injuries were influenced by their culture (including religion). Saudi participants believed that they had limited control to prevent an injury as God was their only protector directing whether they would become injured or not. They also believed that there must be a hidden benefit after negative events like injuries: *"I have been accepted for the coaching license after this injury. I believed that God permitted this to happen for my benefit"* (Saudi 19, 28 years). In comparison no religious explanations for injury were reported by the Irish participants.

Participants' injury prevention behaviour was guided by the team's coach, with a focus on preventing lower-limb injuries. The participants cited three categories of prevention strategies: pre-, during, and after-game. The first were the pre-game [and training] strategies which were performed off pitch for preparation: "*We were just told by our coach to rest, drink a lot of water, eat healthy and just you know, preparing yourself physically and mentally for the football"* (Irish 32, 21 years). The second were strategies used during play, such as wearing shin guards and maintaining concentration. The final group of strategies applied after playing to reduce the effects of fatigue and optimise recovery, such as cool-down exercises and an adequate recovery period. However, varying levels of implementing these injury prevention strategies were described. For example, some participants reported performing more than one measure for cooling-

down (recovery) such as a slow run, muscle stretching, and/or a cold bath, while other participants performed no cool-down.

In general, participants described their implementation of more preventative strategies before and during the game than they did afterwards. Participants generally recognised that their implementation of injury prevention measures was not adequate, highlighting that a coach should take the lead in ensuring that adequate implementation of injury prevention measures are made: *"The period of cool-down with the team is short, they [coaches] don't consider individual needs of the players. I noticed that with longer stretching time I gain more comfort and release of muscles"* (Saudi 5, 24 years). Participants who played for various teams reported that the implementation of prevention measures was different across different teams: *"I noticed that different teams are following different orders of [warm-up] exercises, and I don't know which one is the ideal"* (Saudi 10, 24 years).

Player's age moderated their preventive behaviours. All participants over 30 years of age mentioned adopting a safer playstyle to avoid injuries:

> *"It's not worth making a tackle, it would mean I wouldn't be able to be in work myself, to attend to my three kids, to drive or to be able to do anything. I was kind of conscious of that"* (Irish 34, 38 years).

Some participants aged over 30 years reported taking part in other injury prevention measures. Also, participants over 40 years and those who were mothers reported that weak pelvic floor muscles affected their performance and sometimes influenced their water consumption.

Participants' preventive behaviours were also moderated by their culture or having had a previous injury experience. An injury experience seemed to increase the preventive behaviour of some participants: *"After my injury, I started to concentrate more on my stretches, especially after the heavy work out. During our training, I drink water and do extra stretches to avoid accumulation of fatigue in my muscles"* (Saudi 20, 29 years). In addition, cultural differences inspired the participants' implementation of some preventive measures, as sleeping and diet issues were reported among some Saudi

participants: *"Unfortunately, unhealthy diet is an issue among the Saudi community"* (Saudi 20, 29 years). Overall, Saudi participants were more explicit about using prevention strategies compared to their Irish peers.

4.5.2.2 Subtheme 2: "It is not easy to do ideal injury prevention"

In this sub-theme, the participants described the challenges to injury prevention such as carelessness, lack of motivation, stress of competing commitments (e.g., childcare and work) with playing or practice, and lack of encouragement from the coach: *"The coach doesn't ask us to ever do a warm down* [= cool-down]*"* (Irish 35, 20 years). Another reported barrier was the players' beliefs against the effectiveness of some preventive measures: *"I think it is an issue of beliefs. Some players in my team do not see the importance of warm-up and cool-down and do not do them"* (Saudi 3, 30 years).

Some participants perceived that their sport was undervalued with sporting authorities, which could further reduce the players' motivation to implement prevention. Culture-related beliefs also limited the participants' preventive behaviour: *"To be honest, ignoring the upper limbs during training except for goal keepers is common among Saudi female teams, because they think they will get bulky like men, which is totally wrong"* (Saudi 20, 29 years).

Parental control was another culture-related barrier reported by some Saudi participants: *"Sometimes the time of training is not appropriate for all the girls, some parents don't permit their daughter to attend trainings at night"* (Saudi 19, 28 years). Also, only among Saudi participants, frequent social events such as family visits were reported to interfere with implementing prevention strategies.

Participants reported some organisational rules for amateur women's soccer as barriers to ensuring an adequate recovery period between games, often only 1 or 2 days: *"... I think that's a really big downfall of the leagues. They just don't take into account the recovery periods the athletes need"* (Irish 22, 19 years). This barrier was notably reported by all participants aged over 40 years.

Participants also suggested several facilitators for implementing injury prevention on the player's level. Education on injury risk and prevention, previous injury experience, and

management of time and external commitments were the major facilitators cited by most participants.

Participants' age (life stage and related commitments) influenced the perceived facilitators of their preventive behaviours. Support from one's family (often partners, in particular) was a facilitator for participants who were mothers from both groups, however, support from parents was a facilitator only for some Saudi participants.

4.5.3 Theme 3: "We love the game … but we are undervalued"

In this theme, the participants explained their passion of playing soccer and how they thought that they were not given deserved recognition, despite sacrifices made for the game.

They compared their teams to amateur men's and professional women's teams and described the challenges that they were facing in their amateur level teams which could inhibit implementation of injury prevention.

4.5.3.1 Subtheme 1: "Soccer is my life"

In this sub-theme, the participants described the reasons for their passion of playing soccer, primarily that playing soccer improved both their physical and psychological states, and, for some, decreased the pain associated with menstruation. These observed benefits reinforced players' dedication to the game, which encouraged many to attend games and training sessions even on difficult days: *"Passion of the game encourages the players to attend training during rain or dust storms"* (Saudi 18, 32 years).

The participants were most interested in attending the 'playing part' of the games, and training sessions. Some participants may have skipped the pre- or post-playing injury prevention strategies, e.g., leave the pitch before cooling-down, but never missed playing. At times participants reported having played even with injuries to remain in the game and to support their teams. Playing for sporting achievement seemed generally higher among the Saudi participants when compared with the Irish participants. However, motivations varied among participants based on their age. Younger participants and those aged over 20 years were more motivated to reach higher levels of play and develop skills compared

with participants who were over 30 years, especially working mothers, who also reported their priority was to have a fun time and a break from other commitments:

> *"I was delighted if I got any bit of time on the pitch and the whole idea of me going back to soccer was just for a bit of head space and to get away from the house and the craziness that was going on"* (Irish 34, 38 years).

4.5.3.2 Subtheme 2: "We are brushed under the carpet"

In this subtheme, all participants stated that they did not feel valued by the soccer community when compared with amateur men or professional women, with their teams lacking support and resources such as training facilities and health services. They added that their skills were under-estimated despite the sacrifices they made, such as the regular payments to support their teams (e.g., fees to use the playing field). Some participants compared their teams with professional women's teams: *"these things [health services] were available for professional teams. When I was playing for a higher-level team, things were more professional, we had a club physio"* (Irish 25, 30 years). Most participants compared their teams with amateur men's teams, and male dominance in the game was the main perceived cause of undervaluing in the two groups: *"We are better than boys, but nobody appreciated us; we pay for our teams to buy suits and rent fields. We lack support like boys' teams. Sometimes we don't have a coach and we coach ourselves"* (Saudi 13, 20 years). However, Saudi participants added the low recognition of the women's game in the broader society, because of its late establishment in Saudi Arabia, was a further reason for the feeling of being undervalued.

Participants reported that they were responsible for identifying and managing their own injuries because of a lack of medical staff and equipment (like cold packs or splints). The shortage of support staff forced some participants to fulfil other roles in their teams, such as coaching and managing injuries.

The participants stated that providing more recognition and related resources for their teams could create a better environment to facilitate injury prevention. The presence of female coaches was preferred by both groups (particularly by the Saudi group) to ensure

understanding of female-related issues such as menses and childcare. Culture again influenced the perceived requirements for the ideal facility set-up, with Irish participants preferring equal access to the clubs' facilities as their male colleagues: "*I think ... kind of accessibility to equipment and stuff is the big thing"* (Irish 25, 30 years). However, Saudi participants mentioned that they needed the provision of facilities in their [women-only] clubs.

4.6 Discussion

The present study provides an insight into the experiences of amateur women soccer players regarding soccer injury risk and prevention, highlighting the impact of the players' biopsychosocial characteristics, including age, beliefs, previous injury experience and culture, as moderating factors throughout thematic areas. The potential barriers and facilitators to the uptake of prevention strategies are identified, as well as offering tangible ways to enhance injury prevention strategies for women soccer players.

4.6.1 Most participants lack necessary knowledge to implement adequate injury prevention

The reported causes and preventive measures of injuries in the present study are consistent with evidence identifying risk factors and prevention measures of soccer injuries (Ekstrand *et al*., 2006; Foster *et al*., 2007; DeMarco *et al*., 2011; Ndlec *et al*., 2012; Borges *et al*., 2015; Mutz *et al*., 2020). However, the levels of knowledge regarding injury risk and prevention varied among participants. Most participants reported low implementation of injury prevention measures and inadequate knowledge of injury risk and prevention. Findings reported herein support the evidence recommending accurate, detailed knowledge to inform adequate preventive behaviour (Ajzen *et al.*, 2011). Also, the increased knowledge and implementation of injury prevention after an injury experience is consistent with research regarding risk and preventative behaviour (Verhagen *et al*., 2010).

Participation in injury-prevention strategies was found to be a common challenge among sports communities (Owoeye *et al.*, 2018). Findings presented herein are consistent with a qualitative study among coaches of female soccer teams, wherein it was identified that

the lack of time, coaches' knowledge, and resources were all barriers to implementing injury prevention (Donaldson *et al.*, 2019). For instance, participants in the present study were familiar with some strategies such as running on the field at various speeds (Soligard *et al.*, 2009), soccer drills, and stretching to warm-up (Soligard *et al.*, 2009; Ferraz *et al.*, 2021). However, most participants were not familiar with the adequate time and the correct sequence of warm-up exercises. Coaches' accreditation of an evidence-based, comprehensive warm-up programme with a fixed time and components (FIFA 11+) in their teams can help to encourage the players' implementation of adequate warm-up (Al Attar *et al.*, 2018).

Another explanation for the lower implementation of prevention strategies is that most of the participants did not understand the range of effective injury prevention measures that are available. In this present research programme, the participants were familiar with some cool-down strategies that required extra time in the field, such as slow running and stretching (Van Hooren and Peake, 2018). However, they did not report additional cooldown strategies such as low-intensity cycling (Rey *et al.*, 2018), which can be performed on their way home.

Based on the theory of planned behaviour, improving the players' knowledge of injury risk and prevention would encourage better preventive behaviour (Ajzen *et al.*, 2011). Suggested strategies include formal educational courses to improve the players' level of knowledge on the mechanism of action of risk factors, consequences of not implementing injury prevention, the various options of implementing injury-prevention measures, in addition to the correct and adequate implementation of these measures (Donaldson *et al.*, 2019). Contents of these programmes should be tailored to amateur women players and linked to real-life soccer practice at the amateur level, such as incorporating prevention strategies into a busy life. In addition, education for injury prevention should include parents of younger players and teams' coaches (Donaldson *et al.*, 2019) because they could support the players' implementation of prevention (DeMarco *et al.*, 2011).

Improving knowledge might not be the only factor required to encourage the players' preventive behaviour. An encouraging environment for implementing prevention is equally necessary. According to the self-management theory (Hardeman *et al.*, 2001) providing the required knowledge, skills, and expertise tools would assist players to

improve their preventive behaviour and take a greater role in protecting themselves from soccer injuries (Smalley *et al*., 2019).

4.6.2 Participants' preventive behaviours were influenced by their biopsychosocial characteristics, and the low provision of resources at the amateur level

In the present study, similarities in injury prevention behaviours were reported among participants within the same age category/life stage (e.g., early adulthood at 18–19 years) from both groups. Older participants reported that their younger peers (18–19 years of age) could be aggressive on the field because of their lower recognition of the risk of soccer injuries. In contrast, participants aged over 30 years believed that they were at a greater risk of injury because of their earlier development of fatigue, and they adopted a safer playstyle to avoid injuries that might interfere with their family and work commitments.

Life stage can moderate individuals' behaviours, cognition, intellectual abilities, and their physical and emotional characteristics (Gonzalez-Jimenez, 2017). Aggressive playing style includes any form of tactile or hostile aggressive behaviours that result in a physical or psychological harm to the targeted (opponent) player, with the objective being to win the ball (Gümüşdag, 2021). Aggressive playing is an established risk factor for sports injury (Schwebel *et al*., 2007) and may be associated with a life stage in younger athletes. Aggressive play can result from a perceived lower risk of injury (Rolison *et al*., 2014), higher motivation for achievement in the game (Molanorouzi *et al*., 2015), frustration, anger, overexcitement, or imitating the behaviour of a social idol (Gencheva, 2015). Therefore, monitoring, and effective communication from coaches with youth players will aid development of emotional intelligence (Rutkowska and Bergier, 2015) and improve their preventive behaviour (Abade *et al*., 2014). Educating young players about the consequences of injuries and how to overcome frustration and anger using an appropriate education format for this age group, such as hosting a soccer star figure to talk about these topics (Gencheva, 2015), is recommended.

Participants aged over 20 years have an increased recognition of injury risk compared with their younger peers, consistent with evidence that an individual's recognition of

injury risk increases with their age (Rolison *et al.*, 2014). However, the participants' motivation to play varied after the age of 30 years. Participants aged between 20 and 30 years were motivated to play for achievement. Therefore, these participants from both countries reported higher preventive behaviours compared with the other age group. Whereas participants aged over 30 years had a different motivation to play, which was more about enjoyment because of family and/or work commitments which might alter their priorities for performance during games.

Findings presented herein are consistent with previous studies about motivation and constraints on adults' participation in sports (Ruseski *et al*., 2011; Molanorouzi *et al*., 2015; Mutz *et al*., 2020). Also, participants aged over 30 years in this present research reported that they recognised that they were at higher risk of injury because of the early development of fatigue. This can be related to the reduced physiological adaptation of their tissues to stress and exertion that increases with age (Foster *et al*., 2007). Hence, these participants adopted a safer playstyle on the field to avoid injuries. Considering the player's life stage, including its associated characteristics and commitments, is recommended for effective injury prevention intervention among amateur women.

Players' beliefs can influence their experiences regarding injury prevention (McClure *et al.*, 2010). Beliefs can be described as "an inner feeling that something is true, even if that thing was irrational or unproven" (Moise, 2014). Individuals' beliefs [in turn] can be influenced by their experiences (Hatala, 2012). Participants with a previous injury experience (an individual difference) discussed a higher perceived probability of injury and greater implementation of injury-prevention strategies compared with their uninjured peers. These findings are supported by the Health Beliefs Model, which maintains that an individuals' health beliefs can predict their decision to perform behavioural changes to avoid injury (Munro *et al.*, 2007). Similarly, a study among college athletes showed a perception of higher risk and stronger beliefs in their inability to avoid injuries, and the importance of injury prevention compared with their uninjured peers (Short *et al*., 2004). Therefore, injured players should be provided with accurate evidence-based education on injury risk, and effective rehabilitation programmes that include injury prevention.

Culture can also influence a player's beliefs (Hatala, 2012), and, therefore, moderate player experiences in injury prevention (McClure *et al.*, 2010). Some Saudi players

avoided training their upper bodies to avoid hypertrophy, which they perceived would make them look less feminine. This belief resulted from a gender stereotype which relates muscular body to masculinity (Chalabaev *et al.*, 2009) in the Saudi culture. According to the Health Beliefs Model (Hartley, 2018), this false belief can limit the participation of these players in upper-body training. This belief could be partially explained by the Saudi culture, which considers that upper bodybuilding is an indication of masculinity (Donnelly *et al.*, 2018), in addition to the lack of knowledge about the impact of these upper-body exercises on women's physical appearance (Ajzen *et al.*, 2011).

Upper-body strength is essential for soccer players to avoid injury during collisions with other players (Ruivo *et al.*, 2016). Clarifying the differences between upper-body strength training as a part of bodybuilding and as a part of soccer training should be a component of educational programmes designed for Saudi women soccer players. Poor sleep (Ahmed *et al.*, 2017) and diet (Moradi-Lakeh *et al.*, 2017) described by Saudi participants were consistent with evidence among the Saudi community. Exploring the barriers to implementing these preventive measures (e.g., lack of knowledge about the advantages of a healthy diet and sleep, or the interaction with other commitments) is recommended to inform intervention plans to facilitate healthy sleep and dietary habits for the Saudi group.

Additional significant cultural differences between Saudi Arabia and Ireland moderated participants' experiences in injury prevention. Saudi culture demonstrated separation and unequal distribution of power within families and institutions between genders (Lefdahl Davis and Perrone-McGovern, 2015). Saudi participants viewed their game to be different from that of men's. They recognised that the women's game is new in the country and that it requires time to be recognised and thoroughly developed (Lysa, 2020). The late establishment and low recognition of the game could explain the variations in the provision of facilities between the main and the small cities, as well as the lack of staff in some specialities in the team. It could also explain the lower knowledge base of some Saudi participants about the basics of the game of soccer when compared with their Irish peers. It is recommended that Saudi players are educated about the basics of the game, such as soccer skills and manoeuvres, to reduce the risk of injuries (Giza and Micheli, 2005).

Parental control and social commitments and events such as family visits are common in the Saudi culture [individuals depend on group support] (Lefdahl-Davis and Perrone-McGovern, 2015). These could negatively influence the player's adherence to implementing injury prevention, such as having adequate sleep or attending the team's training sessions. Regular training-session attendance with the team is crucial for soccer players to increase their physical fitness and optimise their performance in their specific playing positions (Di Salvo and Pigozzi, 1998). Informing the players and parents of young players about the advantages of regular attendance of team's training sessions should be an aim of injury prevention educational programmes.

In Ireland, people of different genders generally mix in public settings (Murphy *et al.*, 2003), and people accept and expect an equal distribution of power (Connolly *et al.*, 2019). However, men continue to dominate the game of soccer in Ireland (Liston, 2006), and globally (Albu and Vasilica, 2017). Irish participants described the lack of equity with their male peers as one of the primary challenges to their implementation of prevention measures. Furthermore, there was variation in the provision of facilities between Irish teams in the same city. These findings were supported by gender inequality in finance, with lower support and provision of facilities for women's teams compared with men as a barrier for the development of women's soccer in Ireland (Nolan, 2020).

The lack of facilities and support (including health services) for Irish amateur women soccer players may partly explain the higher prevalence of fatigue and anxiety, and the number of injuries per player reported in a recent study among this group (Alahmad *et al.*, 2021). Socio-environmental factors such as lack of support or value are known causes of anxiety (Giritlioğlu and Erzeybek, 2020), while the inability of the player to attend regular training could result in low fitness, and early fatigue (Wan *et al.*, 2017) and related injuries. Development of self-confidence, physical performance (Sajedi and Kirkbir, 2020), and coping strategies are recommended for these players.

Playing on a muddy field was reported to be a risk factor among Irish participants only. This factor was perceived more by Irish participants because of the frequent weather changes in Ireland when compared with Saudi Arabia (Kottek *et al.*, 2006). The impact of weather changes on the playing surface is an environmental factor that increases the risk of soccer injuries (Waldén *et al.*, 2013). Playing on a wet surface (after raining) was found

to increase the risk of ACL injuries among athletes because of reduced shoe-surface friction (Smith *et al.*, 2012). This may explain the higher incidence of knee and ligament injuries as well as the number of injuries per player reported during a winter season among amateur Irish women soccer players (Alahmad *et al.*, 2021). Therefore, frequent maintenance of the pitches is recommended for the Irish group (Blanchard *et al.*, 2018).

The lower provision of support and facilities described by both groups was consistent with reported lower levels of financial support, health services, provision of facilities and equipment, and qualified staff for female sports teams when compared with those of males (Swanepoel *et al.*, 2015). The shortage of staff in the team reported by both groups placed more pressure (Michie, 2002) on the players as they tried to fill vacancies based on their qualifications, such as coaching their colleagues. The time, commitment, effort, and stress of this extra work interfered with the implementation of prevention among these players (e.g., the player who coaches the team will be under greater stress because of her responsibilities when compared with other players (Michie, 2002)). It is recommended that supports are put in place, so that the players do not have to fulfil other roles in their teams. Support for amateur women's soccer from the Football Federations, which includes providing resources, healthcare, and funding, is required to prevent injury in these teams (Donaldson *et al.*, 2019).

4.6.3 Limitations

This research is the first to include a cross-cultural comparison of injury prevention using qualitative data from amateur women soccer players. The relatively large sample size was a strength of this study, which provided a broad understanding of the players' experiences (Vasileiou *et al.*, 2018), as was the presence of researchers from both Irish and Saudi backgrounds during the analysis. A limitation of the study is that Irish interviewees had to remember their injury occasion from the last playing season (9 months) because of Covid-19 restrictions on soccer practice, possibly reducing clarity for some injury characteristics (not experiences or opinions). However, the period was less than one year which allowed the participants to remember more than 80% of their injury characteristics (Hassan, 2005). Also, there was insufficient depth of detail in the initial Saudi interviews

(about the mechanism of action of risk factors). Hence, five further participants were recruited to gain more in-depth information.

4.7 Conclusion

This research has demonstrated how biopsychosocial characteristics can influence perceptions about injury risk and prevention, as well as the preventive behaviours of amateur soccer players, despite the differences in length of established soccer practice in both countries. Female and age-appropriate tailored educational programmes for players, and coaches and parents of younger players, must be enabled to encourage the implementation of prevention. Providing the required support and resources for amateur teams and considering the player's biopsychosocial characteristics should lead to increased adherence of amateur women soccer players to implementing preventive measures, reduce the risk of injury, and enhancing the enjoyment of the sport for more players with longer careers.

4.8 Self-reflection

Reflexivity involves the "turning of the researcher lens back onto oneself to recognise and take responsibility for one's own situatedness within the research and the effect that it may have on the setting and people being studied, questions being asked, data being collected and its interpretation" (Berger, 2015, p220). Simply, reflexivity means acknowledging the influence of the researcher's background and experiences on their analysis and interpretation of qualitative data. Therefore, in this section, as the primary researcher and analyst, I consider some of the key aspects of myself and my relevant experiences while conducting this study (Berger, 2015).

Berger (2015) regards the following characteristics to be relevant to the positioning of the researcher: "personal characteristics, such as gender, race, affiliation, age, sexual orientation, immigration status, personal experiences, linguistic tradition, beliefs, biases, preferences, theoretical, political and ideological stances, and emotional responses to participants" (Berger, 2015, p.220). I am a PhD student at the University of Limerick in Ireland, and I am interested in preventing injuries among female athletes, particularly soccer players. I worked in clinical practice for 12 years before joining the College of Applied Medical Sciences, King Saud University, as a Lecturer in 2011. I believe that prevention is better than cure, and that a participant's behaviour is influenced by their biopsychosocial factors, including their knowledge. These beliefs led me to develop a passion for training and education in injury prevention, alongside performance enhancement, which I share with my patients and students.

I am passionate about women's participation in sport, which is only recently being encouraged in my country. The importance of women's health is also important to me, especially the disparities between the treatment of men and women in the field of sport, such as the injury profiles and level of education and healthcare examined in this research. I have lived in Saudi Arabia my entire life, yet due to my studies, I moved to Ireland and lived there for three years (2017–2020), which made me somewhat familiar with some Irish cultural nuances. I am a mother of four children between the ages of 10 and 20 years. These experiences have helped me to understand the players' perceptions and experiences and have influenced my interpretation of the study's findings. For example, players who

are mothers reported that their injury prevention practices are challenged by the time constraints associated with their family commitments (childcare). As a mother, I understand exactly what they are talking about and consider that this is a real barrier to implementing injury prevention. Also, I accepted their claim that the provision of childcare at the pitch as a facilitator to implementing injury-prevention practices.

Reflexivity involves paying attention to the complex relationship between processes of knowledge production and the various contexts of such processes, as well as the involvement of the knowledge producer (Haynes, 2019). It has been useful for me to research a cohort of players from Ireland to gain experience and information from a very different perspective based on my background context. In fact, it has been interesting to discover that amateur women soccer players from both countries face similar problems. This is important as during the reflexive process I needed to question my own reality and knowledge of differences.

Interviews with the Saudi women soccer players were conducted in my first language, Arabic. This meant that the participants could speak fluently without struggling with a second language. However, it was even more important to remain neutral throughout these interviews and not to influence the participants because of shared experiences with a culture and language. This is in line with Berger (2015, p.220), who points out that researchers should "carefully self-monitor the impact of their biases, beliefs, and personal experiences on their research; and maintain the balance between the personal and the universal." Therefore, care was taken not to affect the participants' responses through any verbal reaction.

Conceptual equivalence must be ensured in cross-cultural research such as this (Saudi Arabia and Ireland) by considering how words, ideas, and concepts are translated to ensure similar meanings in both languages (He and Van de Vijver, 2012). In addition, to achieving conceptual equivalence, the interviews were accurately translated from Arabic into English with special consideration for any cultural differences (Maisaa, 2011). During the research process, conducting pilot interviews was beneficial. It allowed me to gain more confidence in asking questions and probing the interviewee for more information, which was initially difficult because I did not want to bother the interviewee too much. In addition, going over these initial transcripts with supervisory support led to

great improvements in my style of questioning, and increased my confidence. Therefore, I learned both about the subject area and essential research methods.

Chapter 5 Discussion

5.1 Background

Injuries among amateur women soccer players are higher when compared with their elite and male peers (Klein *et al.*, 2018). Implementing appropriate injury-prevention measures increases the likelihood of reducing soccer injuries (Wiese-Bjornstal, 2010). However, information regarding the implementation of such measures among amateur women soccer players is lacking. To inform effective injury prevention programmes among amateur women soccer players, knowledge about injury prevention behaviours among these players is required (Finch, 2006).

5.2 Research overview

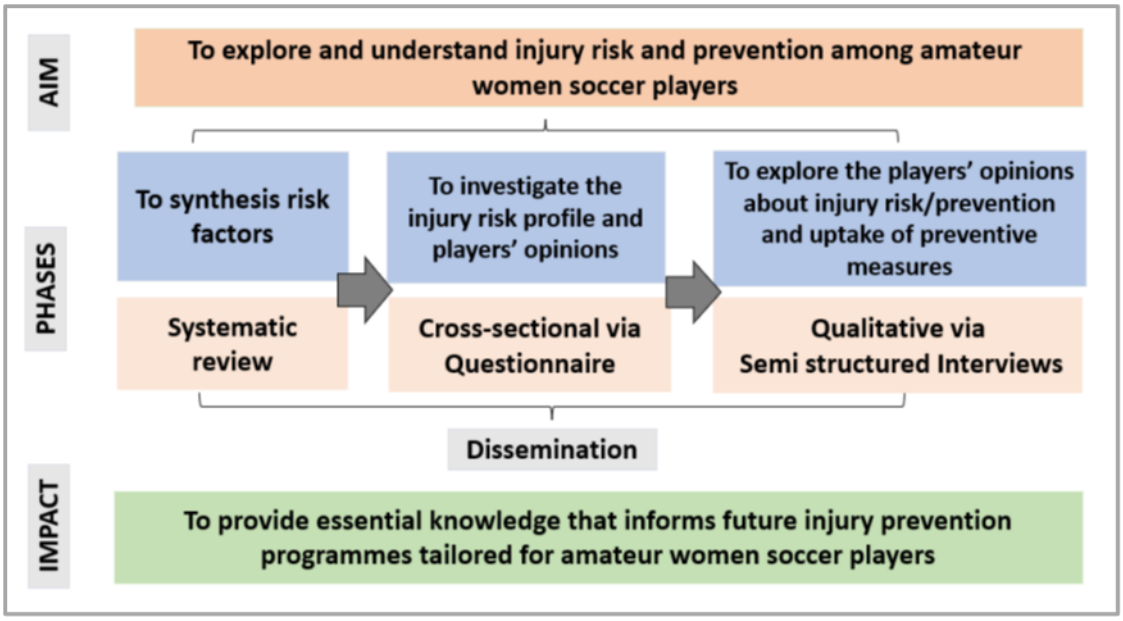
The primary aim of this research programme was to explore the injury risk profile among amateur women soccer players. A secondary aim was to identify amateur women soccer players' opinions on risk factors and prevention measures for injury, the implementation of such preventative measures, and the barriers and facilitators to the uptake of prevention measures among these players. To achieve these aims, a summary of the research methodology and three inter-related phases is presented in Figure 5-1.

Phase one involved a systematic review to synthesise and collate the evidence of risk factors for injury in women's soccer (Chapter 2). Identified risk factors informed the survey used in phase two, a cross-sectional study, which investigated the injury profile, prevalence of risk factors, and players' opinions about risk factors and injury-prevention strategies among a sample of amateur women soccer players in Ireland (Chapter 3). The cross-sectional study found a higher number of injuries per player, and insufficient knowledge about certain risk factors for soccer in the majority of the Irish amateur women players that responded to the survey.

To explore findings from Chapter 3 further, phase three (a qualitative study) was conducted. In this phase, semi-structured interviews were used to explore how amateur women soccer players perceive soccer-related injury risk and prevention, including barriers and facilitators to uptake prevention strategies in Ireland and Saudi Arabia (Chapter 4). The qualitative study also involved a cross-cultural comparison between amateur women soccer players from Saudi Arabia and Ireland to explore how culture may

influence injury prevention behaviours. Phase three identified inadequate knowledge and behaviour to prevent injuries among most of the players interviewed. The players' biopsychosocial characteristics moderated their perceptions and experiences of injury risk and prevention. Figure 1-1 summarises the aim, the three phases and the expected impact of this research project.

Figure 5-1 Summary and plan of the project



This present research demonstrated that the injury profiles among amateur women soccer players differed from their elite peers (Giza *et al.*, 2005; Niyonsenga and Phillips, 2013; Larruskain *et al.*, 2017). Anxiety and fatigue were prevalent and perceived to be risk factors for injury among the studied group. This research also identified insufficient knowledge about injury risk and prevention and inadequate injury prevention behaviours among the studied group, and that these were influenced by several socio-ecological factors. Findings from this research informed recommendations to develop future injury prevention programmes tailored to amateur women soccer players.

This research programme is original in that it is the first to explore injury prevention among amateur women soccer players in Saudi Arabia, where soccer is relatively new among the female population when compared with its more-established state in other countries. Additionally, it is novel in that it includes a cross-cultural comparative study

between Saudi Arabian and Irish amateur women soccer players to explore players' knowledge and preventive behaviours in relation to injury.

This final chapter discusses the main findings from the research presented in this thesis, highlighting the main recommendations to improve players' preventive behaviours, and, therefore, ways to decrease injuries among amateur women soccer players. Recommendations made in the discussion section of each preceding chapter throughout the thesis are here synthesised, and their potential impact on practice is discussed. Potential areas for future research in this field, and limitations of this research are identified.

5.3 Key Findings in the context of the broader literature

5.3.1 Anxiety and fatigue are prevalent and perceived to be risk factors among amateur women soccer players

The systematic review (Chapter 2) identified several intrinsic and extrinsic risk factors for soccer injuries among elite women soccer players. Anxiety and increased soccer exposure (leading to fatigue) were identified as modifiable risk factors for soccer injuries among elite women in the systematic review. When the prevalence of the risk factors was investigated among amateur women players in the cross-sectional study (Chapter 3), greater soccer exposure (in hours) and anxiety were reported among the injured participants when compared with the uninjured participants. Similarly, amateur women players who participated in the cross-sectional study and those interviewed in the qualitative study perceived anxiety and higher soccer exposure to be risk factors for soccer injuries (Chapter 4).

Increased soccer exposure as absolute external load (duration of exposure in a unit of time) was found to be associated with increased fatigue levels (Soligard *et al.*, 2016). Fatigue results from energy depletion and decreases the ability of the tissues to withstand the physiological demands of further physical exertion (Lock *et al*., 2018). Players can experience physical and/or mental fatigue (Slimani *et al.*, 2018). Physical fatigue reduces the coordination and the muscle force required in the lower limbs to kick the ball, which leads to an increased probability of injury (Reilly *et al.*, 2008). Mental fatigue can reduce

a player's motivation, alertness, and cognitive functions required during soccer manoeuvres, thereby leading to injury (Slimani *et al.*, 2018).

Female gender is a predisposing factor for early fatigue (Pedersen *et al.*, 2019). Under similar playing conditions, women can fatigue earlier because of their (generally) lower physical (e.g., body size) and physiological characteristics (e.g., muscle strength) compared with men (Pedersen *et al.*, 2019). In Chapter 3, fatigue was identified as a risk factor for injury among amateur women soccer players, and was more prevalent among injured than uninjured participants.

Amateur women soccer players interviewed in Chapter 4 perceived fatigue to be a risk factor for soccer injuries. This could be explained by the lower level of players' training and conditioning among amateur women, which leads to lower fitness and muscle strength compared with their elite peers (Ostojic, 2004; Lorenz *et al.*, 2013; Altavilla *et al.*, 2017). To increase player fitness levels (and delay the onset of fatigue), coaches are advised to monitor the amount of training and match load (Gabbett, 2016) for each player. This could be achieved by regular measurements of the external load (e.g., duration and frequency) or the internal load (e.g., player's rating of perceived exertion) (Gabbett, 2016). Coaches are also advised to introduce organised fluctuations (increase or decrease) of load with a minimal gradual increase of load for their players during training sessions (Soligard *et al.*, 2016). Load monitoring and management should be introduced on an individual and flexible basis to ensure their effectiveness (Soligard *et al.*, 2016). In addition, there are several strategies a player can engage in to delay the onset of fatigue. For instance, implementing pre-game prevention strategies such as adequate warm-up (Woods *et al.*, 2007) and optimum nutrition (Gravina *et al.*, 2012), in addition to rehydration during in-game breaks (Reilly *et al.*, 2008). Also, endurance/strength training before and during the soccer season can increase a player's resistance to fatigue (Soligard *et al.*, 2016). Players are advised to call for substitutes when they feel fatigued to avoid injury (Reilly *et al.*, 2008).

Anxiety is a further, established risk factor among elite women that was prevalent and perceived to be a risk factor among amateur women soccer players reported herein. Females are predisposed to general anxiety (Jalnapurkar *et al.*, 2018). According to the stress and athletic injury model (Andersen and Williams, 1988), anxiety increases the

player's stress response (i.e., cognitive appraisal of a threatening condition). The stress response, in turn, affects the player's physiological and attention functions. Consequently, the player will have higher muscle tension, narrower visual field, lower attention, and be more easily distracted. These factors will affect the player's performance on the field and increase the risk of injury (Ford *et al.*, 2017).

A study among college athletes revealed greater levels of injury-related anxiety among female athletes than their male peers (Short *et al.*, 2004). A systematic review that examined differences in anxiety across genders determined that women were more vulnerable to anxiety compared with men because of changes in the levels of female sex hormones (e.g., during the menstrual cycle and pregnancy) and lower testosterone levels (Jalnapurkar *et al.*, 2018). Additional anxiety-related differences between the two genders include physiological differences (such as excessive functioning of the hypothalamic pituitary-adrenal axis because of high oestradiol fluctuations in females) and differences in the anxiety-related brain structures (i.e., the smaller volume of the amygdala and larger volume of hippocampus in females) (Narmandakh *et al.*, 2021).

In Chapter 3, anxiety was reported by more than half of participants. Additionally, anxiety was perceived as a risk factor for injury by players interviewed in the interviews reported in Chapter 4. These findings could be explained by players' fear of re-injury (Tripp *et al.*, 2011) or the lower levels of support provided to amateur teams (Giritlioğlu and Erzeybek, 2020). This is consistent with literature that reports social and environmental factors as possibly rendering women more vulnerable to anxiety, particularly in communities that exhibit low gender equality (Hosseini and Khazali, 2013). Therefore, screening for psychological issues, monitoring the players' psychological state (Ivarsson *et al.*, 2021), and providing the required support to highly susceptible players (Bolling *et al.*, 2020) are all recommended for amateur women's soccer teams.

5.3.2 The injury profile of amateur women soccer players differs from that of their elite peers

Most injuries recorded in the cross-sectional study (Chapter 3) were of moderate severity. The knee was the most affected anatomical location, and the ligaments were the most affected structure. The higher knee and ligamentous injuries among amateur soccer

players may be because of reduced knee muscle strength (a consequence of inadequate training) (Szymski *et al.*, 2022) compared with their elite peers. Lower soccer skills (e.g., cutting and landing) during sudden soccer manoeuvres may also increase loading on the knee ligaments and increase injuries among these players (Szymski *et al.*, 2022). Further, the low quality of amateur players' shoes can cause higher friction with the ground on changing direction while playing, increasing the possibility of injury (Luiso *et al.*, 2018). Similar injury profiles were identified in four published studies among Caribbean (Babwah, 2014), British (Fuller *et al*., 2007), Luxembourgish (Lion *et al.*, 2014), and Spanish (Del Coso *et al.*, 2016) amateur women soccer players. In addition, despite gender-related differences (Pedersen *et al.*, 2019), a study among amateur men soccer players showed that the knee is the most-affected location (Bello *et al.*, 2020). Implementing knee-specific prevention programmes such as the 'prevent injury and enhance performance' (PEP) programme, and the 'knee injury prevention programme' (KIPP) (Voskanian, 2013) are highly recommended to minimise knee injuries among these players. In contrast, severe injuries (identified in days lost from match and practice) are more common among elite women soccer players, with quadriceps strains and ankle sprains the most common types (Giza *et al.*, 2005; Niyonsenga and Phillips, 2013; Larruskain *et al.*, 2017).

Differences in the injury profiles of amateur and elite players could be related to playing level differences. It has been reported that competition and skill levels are lower among amateur players compared with their elite peers (Cometti *et al.*, 2001). Elite players were found to have better balance abilities (Hrysomallis, 2011), agility performance (Abdelkrim *et al.*, 2010), anthropometric profiles (Hazir, 2010), and aerobic fitness and muscle power (Ostojic, 2004). Elite players were also identified to perform better than their amateur peers in mental skills such as stress reaction, self-confidence, focus, imagery, goal setting and commitment (Erciş, 2018). These differences may explain the different injury patterns across different playing levels (Lorenz *et al.*, 2013; Altavilla *et al.*, 2017).

Most of the amateur players interviewed in the qualitative study (Chapter 4) reported self-managing their injuries and returning to play too early, even with pain. Returning to play before adequate rehabilitation of a soccer injury is a predisposing factor for recurrent

injury (Faude, 2006; Nilstad *et al.*, 2014). This could be due to the existing mechanical and/ or functional deficits after the initial injury (Faude, 2006). Adequate rehabilitation is the restoration of the anatomical and functional levels (required for return to play) (Frontera, 2003) of a previously injured body. Injured amateur players may have self-managed because of a lack of medical input at their playing level, as reported by amateur women interviewed in Chapter 4. These players perceived that the amount of support, including the access to health services, was lower than their elite peers. The reduced health support for amateur women soccer players is also consistent with two studies among male soccer players (Van Beijsterveldt *et al.*, 2015; Altavilla *et al.*, 2017). Injury prevention interventions should aim to improve amateur players' soccer-related characteristics such as strength and fitness to reduce the risk of injuries among these players. Education about the consequences of returning to play before adequate recovery, improving the training facilities, and providing health services for amateur women players are all highly recommended to ensure adequate management and rehabilitation of injuries among this cohort.

5.3.3 Multi-level socio-ecological factors influenced the lack of knowledge on injury prevention, and the inadequate injury-prevention behaviours among amateur women soccer players

The cross-sectional study (Chapter 3) found higher injuries per player among Irish amateur women soccer players when compared with their Spanish peers, as reported also by Del Coso *et al.* (2016). Also, half of the participants had received no education regarding injury risk or prevention strategies. Most participants did perceive playing position and joint hypermobility to be predictors of soccer injuries. However, these factors were identified in the systematic review (Chapter2) as risk factors for soccer injuries among women soccer players. The qualitative study (Chapter 4) provided several explanations for these findings among Saudi and Irish amateur women soccer players. Despite cultural differences, most of the players interviewed believed that education on injury prevention had not been prioritised. They also described inadequate behaviours to prevent soccer injuries such as poor sleep or insufficient warm-up. In addition, the players reported several challenges to implementing injury prevention strategies, such as time constraints, organisational roles, being undervalued by their community, and a lack of

resources for their teams. Furthermore, the biopsychosocial characteristics of the players moderated their perceptions and experiences of injury risk and prevention.

Aforementioned findings are supported by a socio-ecological model, which considers the individuals' interactions with their physical and social environments as a determinant of their behaviour (Bogardus *et al.*, 2019). According to this interaction, this model categorises the barriers to the individual's behaviour into the five levels of: intraindividual, inter-individual, organisational, community, and policy (Allegrante *et al.*, 2010; Bogardus *et al.*, 2019). According to the TRIPP model, identifying and addressing the barriers/facilitators of players' preventive behaviour is recommended to encourage players' implementation of injury prevention strategies to reduce soccer injuries (Finch, 2006). Identifying and addressing these barriers could be achieved through a complete multifactorial approach suitable for each socio-ecological level. This approach involves a comprehensive multidisciplinary customised intervention (Edouard and Ford, 2020).
The strategies suggested to reduce the barriers to the players' preventive behaviour using the socio-ecological model will be discussed below (implications for practice).

5.4 Recommendations of findings

This research project suggested valuable recommendations to improve the players preventive behaviour and increase their adherence to injury prevention programmes to reduce injuries among amateur women soccer players. Research recommendations are summarised in Figure 5-2.

Figure 5-2 Main research recommendations

The level of knowledge of all stakeholders

5.5 Implications of the findings

5.5.1 Implications for practice

This research programme determined that amateur women soccer players have a different injury risk profile to their elite peers. In addition, it found that most soccer injury prevention programmes implemented at the amateur level were not tailored for women, did not consider the players' biopsychosocial characteristics, and were restricted by several barriers on the individual and team levels. Adequate knowledge about soccer injury risk and prevention was also not common among amateur women.

Injury prevention programmes should consider playing level differences (Lorenz *et al.*, 2013), in addition to variable anthropometric, physiological (Pedersen *et al.*, 2019), and performance characteristics (Altavilla *et al.*, 2017) between men and women. Considering biopsychosocial characteristics, addressing barriers to implementing injury prevention measures, and providing adequate knowledge, all assist in encouraging players' preventive behaviour, and, therefore, the reduction in injuries (Finch, 2006; McClure *et al.*, 2010). Hence, modifications to existing training programmes applied in amateur soccer teams are suggested to tailor them for women players, such as improving

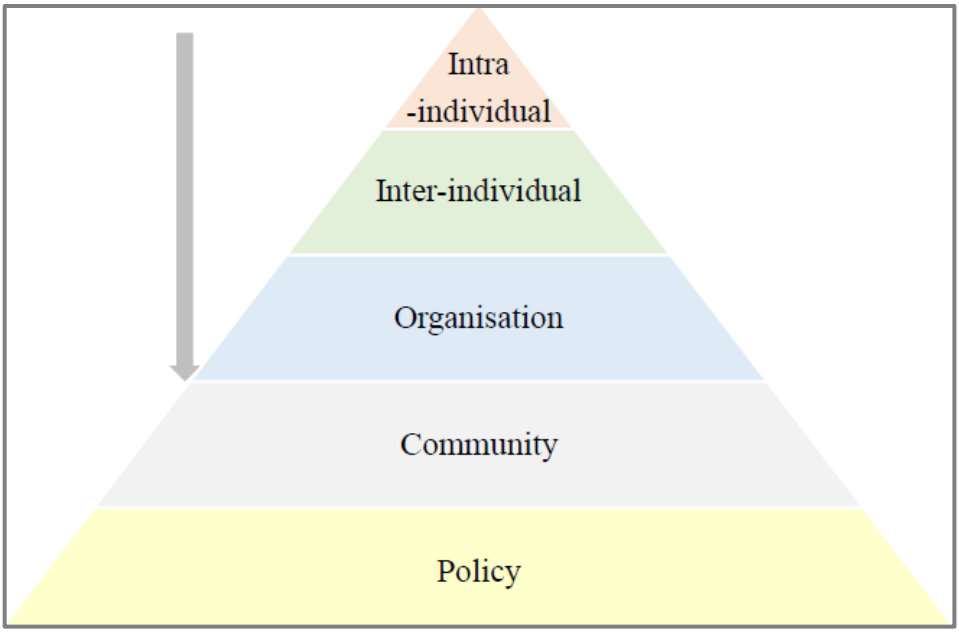
the players' fitness level to reduce the onset of fatigue. Additionally, recommendations to enhance player knowledge of injury risk and prevention, and to encourage their implementation of injury prevention measures by addressing barriers, are introduced. Identifying and addressing barriers using the socio-ecological model provides an efficient framework for specialists in sports injury prevention (Bogardus *et al.*, 2019). Knowledge (about injury risk and prevention) alone is not adequate to encourage the players' preventive behaviour (Hardeman *et al.*, 2001). Knowledge should be supported by providing the required facilitators (i.e., support and skills) for the players to implement prevention strategies and to bear personal responsibility for avoiding the causing of injuries, either to themselves or to other players (Smalley *et al.*, 2019).

The following suggestions (5.5.1.1) to improve players' preventive behaviours are based on the barriers and facilitators of implementing injury-prevention measures reported by the participants in the qualitative study (Chapter 4). While some of the research implications discussed in this section are forms of best practice, logistical, practical and financial constraints may hamper their implementation among women's teams at the amateur level. Preventing sports injuries by applying safe behaviours is essential for athletes to enjoy long sporting practice (Verhagen *et al.*, 2010).

5.5.1.1 Suggested strategies to reduce the barriers to the players' preventive behaviours

These strategies have been categorised based on the socio-ecological model (Figure 5-3). The expectation is that these strategies will reduce barriers to player implementation of injury-prevention strategies, and that they will provide an environment that facilitates the players' preventive behaviour. These strategies have been developed to encourage preventive behaviours and reduce injuries among amateur women soccer players.

Figure 5-3 Barriers to players' implementation of injury-prevention strategies organised in levels based on the socio-ecological model



5.5.1.1.1 The intra-individual level

This level represents the player's characteristics, including her knowledge, skills and behaviour, as they interact with the environment and society (Allegrante *et al.*, 2010). Behavioural modification is required to encourage the implementation of injury prevention measures/programmes among amateur women soccer players (Finch, 2006). Human behaviour theories such as the theory of planned behaviour (TPB), health beliefs model, or the self-determination theory, can be used to understand and modify player's behaviour based on information about their biopsychosocial characteristics (Santi and

Pietrantoni, 2013; Duminica, 2020). Education and increasing awareness of injury risk and prevention are essential facilitators of players' preventive behaviours (Ajzen *et al.*, 2011). For example, Saudi participants in Chapter 4 reported that dietary and sleep issues were common in their culture, which formed a barrier for them to maintain adequate sleep and a healthy diet. Therefore, based on the TBP, educating Saudi players about proper sleep and a healthy diet may encourage appropriate implementation of these preventive measures.

Multidisciplinary interventions have been shown to effectively identify and address individual barriers to the player's preventive behaviour and reduce sports injuries (Tee and Rongen, 2020). As anxiety and fatigue were found to be prevalent and perceived to be risk factors among amateur women soccer players, a collaboration between the soccer related staff to manage these risk factors is recommended. Ideally, this means collaboration between a psychologist and the team's coach to reduce the players' anxiety or between the physiotherapist, fitness coach, and the team's coach to delay the onset of fatigue among amateur women.

Table 5-1 below presents a suggested injury-prevention programme for amateur women soccer players that has been developed based on findings and acquired knowledge across this thesis research programme, with examples. This programme involves two stages (pre-season and in-season interventions) tailored for amateur women soccer players, and considers their biopsychosocial characteristics based on findings from this research project. The pre-season interventions aim to identify risk factors (mainly modifiable, which can be targeted by prevention measures). In addition, pre-season interventions aim to educate and train the players to minimise the effect of these risk factors, and to develop the strength, fitness, and skills required during the season (Ekstrand *et al.*, 2020).

The pre-season intervention stage comprises three parts, based on the targeted groups: all players, all stakeholders, and players at increased risk of soccer injuries. The programme also includes in-season interventions to maintain the strength, fitness, and skills gained before the season, and to implement the prevention strategies learned during pre-season education (Ekstrand *et al.*, 2020).

The in-season intervention stage comprises six parts, based on the timing of intervention: pre-game, in-game, and post-game interventions (post-game interventions include the immediate post-game prevention measures and the recovery period). In addition, this

stage includes frequent re-evaluation and continuous follow up of the players, which should be applied throughout the season. An example with player X, a 40-year-old Muslim working mother with two children who need her care, is used to clarify how these strategies could be implemented. Player X had anxiety and was at risk of higher anxiety (related to stress of commitments) and fatigue (her age). Examples of suggested strategies tailored for this player are provided at the end of each section.

Table 5-1 Suggested injury-prevention programme for amateur women soccer players

<table>
<tr><th>Pre-season intervention stage</th><th>In-season intervention stage</th></tr>
<tr><td rowspan="2">Strategies targeting all players:
- Comprehensive evaluation to identify risk factors prevalent among amateur women (i.e., anxiety, fatigue)
- Identifying players' individual needs (e.g., extra stretching or strengthening after a previous injury)
- Preseason interventions should consider the players' biopsychosocial characteristics, such as their culture and age
Identifying the barriers/facilitators of injury prevention at the team level and addressing them (e.g., time constraints are barriers for some players and setting a training time slot that suits all players will encourage their participation in the team's training session).
<u>Suggested strategy for player X</u>: Her coach has to recognise that this player needs cooperation to manage her commitments and attend team warm-ups. The coach must discuss this with the player before the season and identify the facilitators of and barriers to her attendance and help her to address them (such as an appropriate session time slot). The player herself should acknowledge any issues and constraints of her preventive behaviour to her coach.</td><td>Pre-game strategies:
- Implementing adequate pre-game prevention measures. This prevention should be designed based on the individual needs of the players (e.g., more warm-up exercises for players with previous injuries)
<u>Suggested strategy for player X:</u> Player X has to have adequate sleep/diet/ hydration before the game. She has to implement more warmup before the game/practice (longer duration or higher frequency) than her younger peers. The team coach has to consider her age, fitness level and physical abilities on prescribing her warmup routine to avoid overload.</td></tr>
<tr><td>In-game strategies:
- Implementing prevention measures during the game. Hydration during in-game breaks will help to delay the onset of fatigue (e.g., goalkeepers are advised to drink water if the ball is far from the goal). Also, implementing</td></tr>
</table>

	proper jumping and landing techniques during the game will help to reduce lower limb injuries Suggested strategy for player X: She should utilise the small in-game breaks to rehydrate, and perform quick stretches
Strategies targeting all stakeholders: - Enrol all stakeholders in education about injury risk and prevention. This education should include correcting inaccurate beliefs that restrict the players' implementation of injury prevention (e.g., educating the Saudi players about the differences between upper body strength training as a part of bodybuilding and as a part of soccer training) Suggested strategy for player X: Her coach must be familiar with warm-up strategies, especially evidence-based programmes such as FIFA 11+, and how to control player training and game load - Enrol players in strength, conditioning, balance, and fitness training to delay the onset of fatigue and reduce injuries Suggested strategy for player X: She needs training to increase her strength and fitness - Interventions must consider the characteristics of women players (e.g., their physical and physiological characteristics that lead to the early development of fatigue, and the time constraints of the working mothers) Suggested strategy for player X: Player X is 40 years old, she needs more warm-up than younger players in preparation for the game and practice - Interventions must be applicable at the amateur level (e.g., implementing strength training using the available facilities in the club), provided at suitable time for all players especially those with family/work commitments Suggested strategy for player X: A pitch side safe area for children would reduce stress as her children could accompany her to the pitch. She must familiarise herself with various warm-up strategies, and implement the most appropriate one for her	*Post-game strategies:* - Implementing post-game prevention measures - Players who must leave the pitch early because of other commitments should learn about alternative measures to the team's cool-down (e.g., cycling home or doing muscle stretches at home). Most importantly, they should learn how to implement adequate cool-down Suggested strategy for player X: She needs to self-educate about how to adequately cooldown, and research options to do so at home if she has to leave the pitch early
Strategies targeting players at risk of injury:	*Strategies between the games:* - Implementing an adequate recovery period (length and content) and ensuring sufficient

- Provide the required support for players at higher risk of injury based on their needs (e.g., strengthening the players' weak muscles after previous injuries, and social and psychological support for players at risk of anxiety). Suggested strategy for player X: She should seek specialist psychosocial support to manage her anxiety - Interventions must consider the players' biopsychosocial characteristics and the barriers/facilitators of injury prevention at the team level. For instance, education on energy conservation for Saudi players can help delay fatigue onset during games in Ramadan (the holy month of fasting). Suggested strategy for player X: Before Ramadan season, player X has to be trained and educated on energy conservation to delay fatigue	recovery between games, especially during congested leagues. Educating the players on how to achieve full recovery is also recommended Suggested strategy for player X: She must learn how to achieve adequate recovery and manage her work/home commitments to find adequate time to implement recovery *Strategies throughout the season:* - Re-evaluation of all players to identify players at risk of injury during the season (e.g., evaluate their muscle strength because it can decrease with injury or inadequate training) - Follow up with players at higher risk to ensure proper implementation of injury prevention to avoid injuries. For example, coaches should build a good relationship with young players (18–19 years of age), improve their soccer skills and monitor their playstyle to reduce in-game aggression Suggested strategy for player X: The coach must regularly communicate with her during the season to ensure that she is managing her anxiety and seek help if required (unless the team has a psychologist, which is not common for amateur teams

5.5.1.1.2 Inter-individual level

This level includes the immediate physical environment in which the player lives, in addition to her social links, including family, friends, coaches, and teammates (Allegrante *et al.*, 2010). Similar to the intra-personal level, education and increasing awareness of injury risk and prevention are essential requirements at this level. Participants in Chapter 4 reported time constraints (i.e., interference between their family/work commitments, and the time to perform cool-down or warm-up with their teams) to be barriers to implementing adequate injury prevention with their teams. Findings presented herein are consistent those that have discussed family commitments (e.g., care for children) and work stressors (e.g., long working hours) as constraints for

adults' participation in and the time spent on sport in sports participation and time spent in sport (Ruseski *et al*., 2011; Mutz *et al*., 2020).

Players also claimed that their coaches were not considering players' individual needs (e.g., having a previous injury). They added that there was no fixed warm-up routine to follow, and that they lacked an encouraging environment for implementing injury prevention in their teams. Considering the players' individual needs, such as time constraints or having a previous injury, will help to increase the effectiveness of injury prevention measures and encourage their preventive behaviour (Dhillon *et al.,* 2018). Therefore, training coaches to evaluate and address players' individual needs is recommended. Additionally, coaches are advised to implement an evidence-based warm up routine such as FIFA 11+ with fixed time and components that ensure adequate warm up for all players (Al Attar *et al.,* 2018).

Team coaches are the primary source of players' knowledge about injury risk and prevention, and one of the key motivators of the players' preventive behaviour (McKay *et al.*, 2014; Nasr, 2019). Therefore, coaches are advised to facilitate an environment that encourages player preventive behaviour through the building of positive relationships with team players. This positive relationship can be achieved through clear active communication to identify and address the barriers to the players' preventive behaviour (Abade *et al*., 2014).

Educating the family members involved (i.e., parents of young players and life partners of players who are mothers) about the advantages of the regular attendance of the team's full training sessions in reducing injuries is required. This education can encourage the families to support the players' implementation of injury prevention strategies with their teams.

Educating coaches about the importance of considering the players' individual needs, and ensuring the adequacy of training for these players would help reduce injuries. Educating and training coaches to adopt evidence-based, comprehensive prevention programmes such as FIFA 11+ should also help to reduce injuries (Al Attar *et al*., 2016). Reducing player anxiety could be achieved by encouraging good communication between the coach and the players about injury prevention. It would also help identify the barriers to and facilitators of players' preventive behaviour, and to increase their adherence to the team's injury prevention strategy (Bogardus *et al.*, 2019).

Developing camaraderie among team members by encouraging teamwork and cooperation between players during implementing injury prevention, such as helping a teammate do adequate muscle stretching, is also recommended (Bogardus *et al.*, 2019).

5.5.1.1.3 Organisational level

This level focuses on the football club, including its facilities, rules and regulations (Allegrante *et al.*, 2010). Suggested ways to encourage the players' implementation of injury prevention at this level include providing the required facilities for training or access to these facilities, as reported by participants in Chapter 4. Provision of equipped pitches that are also frequently maintained is also essential. The selection of time slots that suit all players, and short, easy to perform programmes, is also required (Bogardus *et al.*, 2019). Having medical staff on the team and first aid equipment would also be beneficial (Tee and Rongen, 2020).

5.5.1.1.4 Community level

This level includes the geographical or political borders of the players and their teams (Allegrante *et al.*, 2010). Participants in the qualitative study (Chapter 4) cited the low recognition of women's amateur soccer in their community as a barrier to implementing injury prevention behaviours. Suggestions to encourage the players' implementation of injury prevention measures at this level may include increasing community awareness about the importance of injury prevention in amateur women's soccer (Bogardus *et al.*, 2019). This could be achieved through coordination with local universities to implement educational campaigns carried out by the students of physiotherapy, sports science, or medicine, which target various stakeholders (Bogardus *et al.*, 2019). These campaigns should provide information on injury prevention, such as the role of the family in supporting the players' safe soccer practice, management of anxiety in women players, and how to achieve full recovery.

5.5.1.1.5 Policy level

This level includes higher authority systems, often with political boundaries, which have the means to provide resources and control the sporting community, such as the Football Federation and Ministry of Sport. This level also focuses on improving the perspective of society on injury prevention (Allegrante *et al.*, 2010) in amateur women's soccer.

In Chapter 4, Saudi players reported that they developed knowledge about soccer only when they joined their teams, unalike their Irish peers. Therefore, they all cited education on soccer skills and injury prevention as an essential topic in their future educational programmes. Also, fatigue was prevalent and perceived to be a risk factor among the amateur women who participated in this research. Players blamed the league organisers for the inadequate recovery period during congested leagues.

Suggestions to encourage the players' implementation of injury prevention measures at this level include increasing the society's awareness of injury prevention in amateur soccer, such as incorporating a mandatory subject about injury prevention in the high school curriculum for girls (Bogardus *et al.*, 2019). Facilitating research targeting amateur women soccer players to develop injury-prevention programmes (Bogardus *et al.*, 2019) tailored for this group would also be advantageous. Also, to reduce the onset of players' fatigue, the application of the modified laws of the game that has been agreed upon at the 131st annual general meeting of The International Football Association Board should be guaranteed by the football associations. These laws include reducing the pitch size, goal size, and duration of the two halves of the match (IFAB, 2018). In addition, to ensure full recovery, it would be helpful if specialists in the field could encourage lawmakers to make policy changes (Bogardus *et al.*, 2019) through direct discussions (e.g., adequate recovery period between games).

5.5.2 Implications for research

Future research on amateur women soccer players would benefit from longitudinal injury surveillance among large populations of amateur women players, using definitions of soccer injuries that take medical attention and time loss into consideration, so as to avoid missing any injuries in analysis. To improve the literature in this area and to provide comparative data with other groups of athletes, these surveillance studies should provide detailed information about injuries, including injury incidence during an adequate length of the soccer season.

Prospective studies investigating risk factors for soccer injuries, especially female-related ones (e.g., menses), are essential to inform tailored injury prevention programmes (Sedgwick, 2014a). A comparison of age groups among amateur women soccer players is also required to ascertain the effect of age on the injury risk profile and player's preventive behaviour in this cohort. Comparative studies on the epidemiology of injury

between amateur women soccer players and women soccer players from different playing levels (i.e., elite, sub-elite, and recreational) are also called for. These studies can provide applicable guidelines for injury prevention among players at each level (Van Beijsterveldt *et al.*, 2015). Cultural differences must be considered in studies exploring soccer injury epidemiology, risk, or prevention, to ensure the fair reporting of findings and the applicability of recommendations for amateur women soccer players from different regions (Eirale *et al.*, 2017).

Qualitative studies in this field that include stakeholders and are conducted in various regions are recommended to increase the understanding of the potential barriers and facilitators to players' preventive behaviour (Finch, 2006). Finally, development of educational guidelines for injury prevention and behavioural changing programmes tailored towards amateur women players, and studies to examine their effect on soccer injury incidence are recommended.

5.5.2.1 Future research among Saudi and Irish players

There is a lack of research on soccer injury risk and prevention among amateur women soccer players in Saudi Arabia and Ireland. Further exploration in this area, guided by the section on implications for research in this chapter, is required to inform future prevention programmes tailored towards amateur women soccer players. The recommendations for future research in this section are tailored to Saudi and Irish amateur women soccer players, with slight variations because of differences in the length of the soccer season and the aims/design of the first research in each country.

For the Irish group, the first research was a cross-sectional study (Chapter 3). This study provided a snapshot of the injury risk profile among Irish amateur women soccer players. However, it was conducted throughout a single winter season (broached as a limitation in Chapter 3). To facilitate comparison with other studies, the recommended minimum length of investigations is two successive winter or summer seasons. In addition, a comparison between winter and summer will provide information about the impact of climate differences on soccer injuries in Ireland. Prospective studies of an adequate length (two successive seasons) are required to identify risk factors for soccer injuries among Irish amateur women.

The first research among amateur Saudi women was qualitative (Chapter 4). This study explained the players' perceptions of injury risk and prevention, their preventive behaviour, and the barriers to and facilitators of that behaviour. However, information regarding injury risk profiles among the Saudi group is lacking. Therefore, the next step for Saudi women soccer players should involve prospective studies to investigate injury profiles and to identify risk factors for soccer injuries throughout an entire soccer season.

Future cross-sectional studies among Saudi and Irish soccer-playing women may investigate the barriers and facilitators to injury prevention within amateur teams (e.g., the provision of facilities, the level and quality of health services provided, and the level of communication between the coach and the players regarding injury prevention). Findings from studies of this nature would build upon what has been explored in Chapter 4. Furthermore, qualitative studies to explore the level of knowledge regarding injury risk and prevention among other stakeholders in amateur women's soccer are required to confirm the reported lack of knowledge among stakeholders set out in Chapter 4.

5.5.2.2 Dissemination of the knowledge gained from this research programme

This research programme provides valuable and novel information to promote the wellbeing and safety of amateur women soccer players. Information regarding preventive behaviour strategies among amateur women soccer players is currently lacking, with nothing available to enlighten future injury-prevention guidelines for this cohort.

The injury profiles of amateur women differ from their elite peers because of differences in player characteristics and availability of resources between the two levels. Fatigue and anxiety are prevalent and perceived to be risk factors among amateur women soccer players. Preventive behaviours are influenced by several socio-ecological factors which should be identified and addressed to encourage the implementation of injury-prevention measures. Concerted efforts from all stakeholders are required to identify and address the players' socio-ecological factors at the amateur level of women's soccer.

Future injury prevention programmes targeting amateur women soccer players should be both tailored for women players, and applicable at the amateur level. Coaching and health specialists in the field could benefit from research results reported herein, and the two articles published from this research (Alahmad *et al*., 2020; Alahmad *et al*., 2021) to

improve the players' implementation of injury-prevention measures, and therefore decrease injuries among amateur women.

Disseminating this information as a published academic work will not ensure the maximal understanding by stakeholders in amateur women's soccer. Therefore, both the thesis and two peer-reviewed journal articles resulting from it, should be augmented with lectures and workshops on injury risk and prevention to stakeholders from the Irish and Saudi groups in coordination with the sporting/governing organisations. Contents of these lectures and workshops will be tailored towards women playing for amateur soccer teams, related to real-life practice, presented in an appropriate format, and delivered at times suitable for the target audience. Providing stakeholders' education programmes before the beginning of the soccer season can help to improve the players' implementation of injury-prevention measures during the season (Owoeye *et al.*, 2020). Applying knowledge gained from this research is expected to encourage the implementation of injury prevention measures (increase preventive behaviour) among amateur women's teams. Therefore, this should help to reduce injuries among amateur women soccer players.

5.6 Strengths and Limitations

This research is the first of its kind to explore injury prevention among Irish and Saudi amateur women soccer players. It is also the first cross-cultural study to compare injury prevention behaviours and players' perceptions among women soccer players. However, it has several limitations that should be acknowledged.

The limitations of individual phases of research have been broached throughout the thesis. The main limitations of the research programme in entirety are: no prospective study is included. Prospective studies are the best choice to identify risk factors (Akoto *et al.*, 2018), although investigating injury epidemiology was not an aim of this project (not considered as part of the present thesis methodology). The project aimed to provide information about player preventive behaviours in amateur women's soccer teams. Therefore, providing a snapshot of the injury profile and prevalence of risk factors, and exploring player perceptions of injury risk and prevention and their preventive behaviour, were appropriate to achieve this aim. Additionally, this research has used a single definition to report injuries, which was based on time lost from training and matches.

Using a single injury definition might lead to the omission of injuries that did not involve time loss (players continued to play after injury). However, this is an accepted and widely used definition among soccer populations (Dompier *et al.*, 2007). Given that this research aimed to explore the injury-prevention behaviour of players, and studies involved retrospective self-reporting of injuries, time-loss injuries are easier to recall than non-time loss injuries because they are associated with a disability and cost (Dompier *et al.*, 2007). Confirming the injury data collected from the amateur players by comparing them with the teams' medical records was not possible because of a lack of medical personnel in the Irish and Saudi amateur teams. Therefore, the recall period was reduced, and the time loss definition of injuries was used to enhance data recollection (Dompier *et al.*, 2007).

5.7 Conclusion

The findings from this research provide valuable and novel information regarding injury risk among amateur women soccer players in Ireland and Saudi Arabia. These findings contribute to the scant literature on this cohort, and in the field of culture and sport. Therefore, it is envisaged that this thesis will inform future injury-prevention interventions tailored towards amateur women soccer players and serve as a reference to provide guidelines for future research to improve player safety.

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Appendices

Appendix 1 List of publications

1.1 University of Limerick research week poster

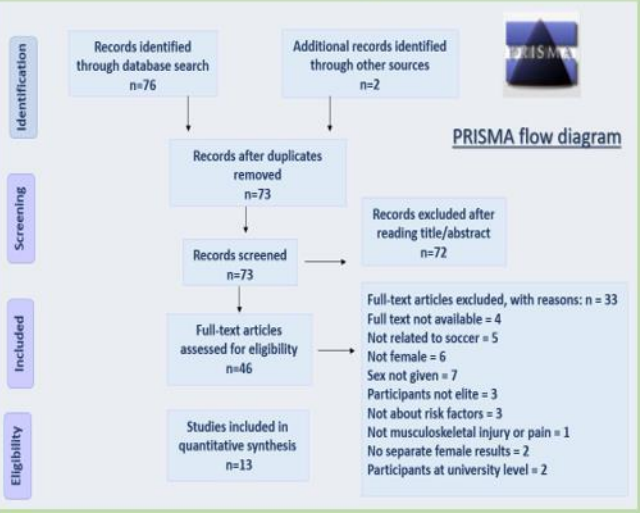
Risk Factors for Injury in Elite Female Soccer Players: A Systematic Review

Tahani Alahmad SPhD student SAH, Roisin Cahalan SAH, Phillip Kearney PESS

Background:
There has been a dramatic increase in female soccer participation that coupled with increased incidence of severe injury in this population[1,2]. The high injury incidence has been found to impact negatively upon the related league, the clubs affected,and the well-being of the players [3]. Despite the importance of risk factor identification in injury prevention, studies investigating pain and injury in this cohort are still lacking[4], and findings of male studies may not be wholly generalizable to female players[5].

Aim: To identify potential risk factors for injury in elite female soccer players.

Methods:
- 10 electronic databases searched (December 1980 and January 2018).
- Quality assessment: CASP checklist.
- Level of evidence: Oxford Center of Evidence-Based Medicine guidelines.



Factors that increase injury/pain:
- Increased joint laxity.
- Increased BMI.
- Leg dominance.
- Previous injury.
- Specific playing position.
- Higher level of competition.
- Psychological issues.
- Low H/Q ratio.
- Higher performance in square-hop test.
- Lower knee valgus in drop jump landing.
- Low postural sway of both legs.

Factors that decrease injury/pain:
- Use of protective bracing.

Factors with conflicting findings:
- Female hormonal fluctuations.
- Increased soccer exposure.
- Increased age.

Factors that have no effect on injury:
- Variability in Q-angle, intercondylar notch width, or pelvic width measurements.

Conclusion:
- The risk of pain and injury in elite female soccer players is multifactorial, complex, and associated with intrinsic and extrinsic factors.
- More high-quality studies are required to confirm each identified risk factor. and explore believes of elite female players regarding these factors.

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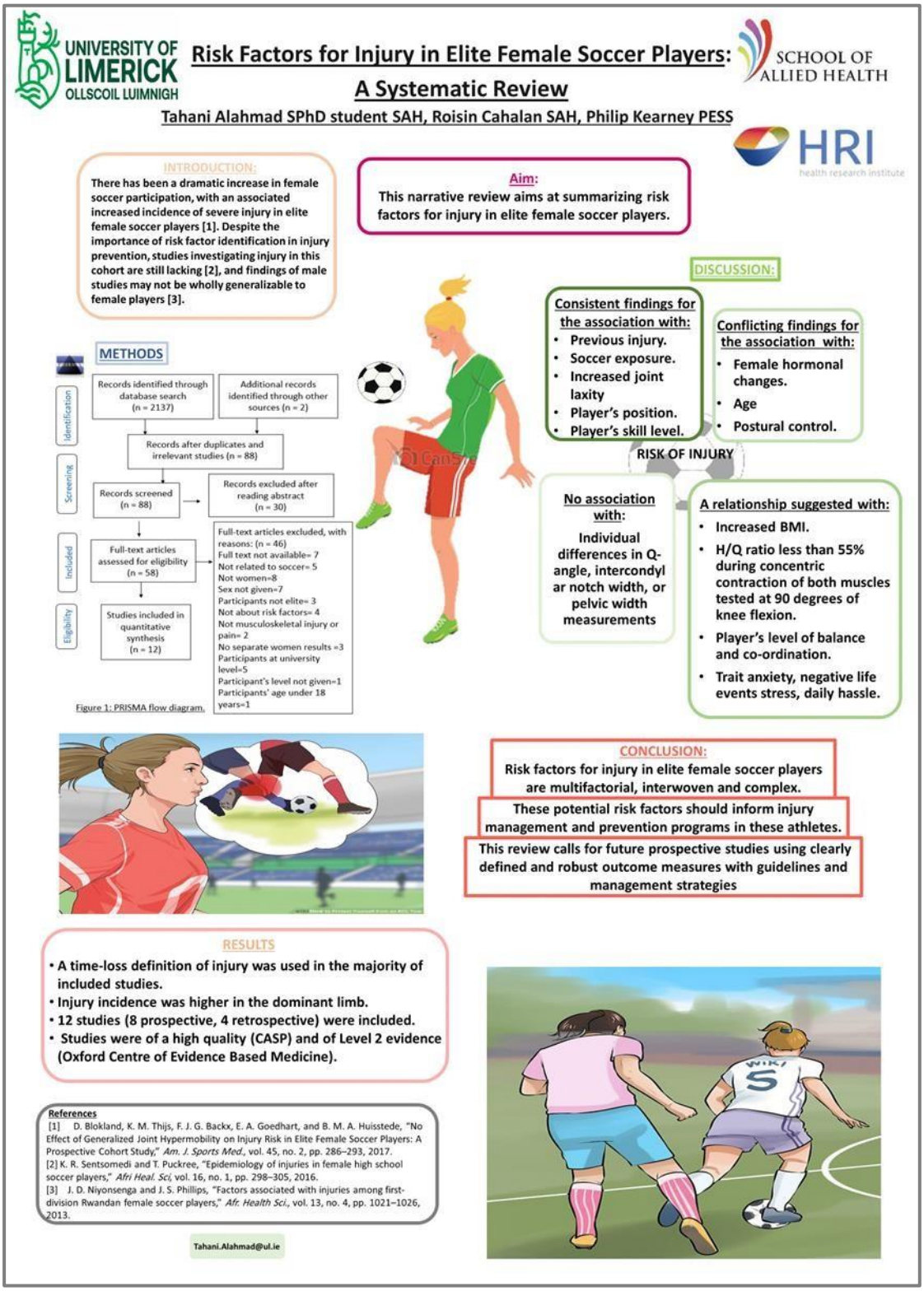
1.2 Irish Society of Chartered Physiotherapists (ISCP), conference poster



1.3 Announcement of a Zoom lecture

Appendix 2 Appendices for Chapter 2

2.1 Research Output (Manuscript of the systematic review)

The Physician and Sportsmedicine

ISSN: 0091-3847 (Print) 2326-3660 (Online) Journal homepage: https://www.tandfonline.com/loi/ipsm20

Injury in elite women's soccer: a systematic review

Tahani A. Alahmad, Philip Kearney & Roisin Cahalan

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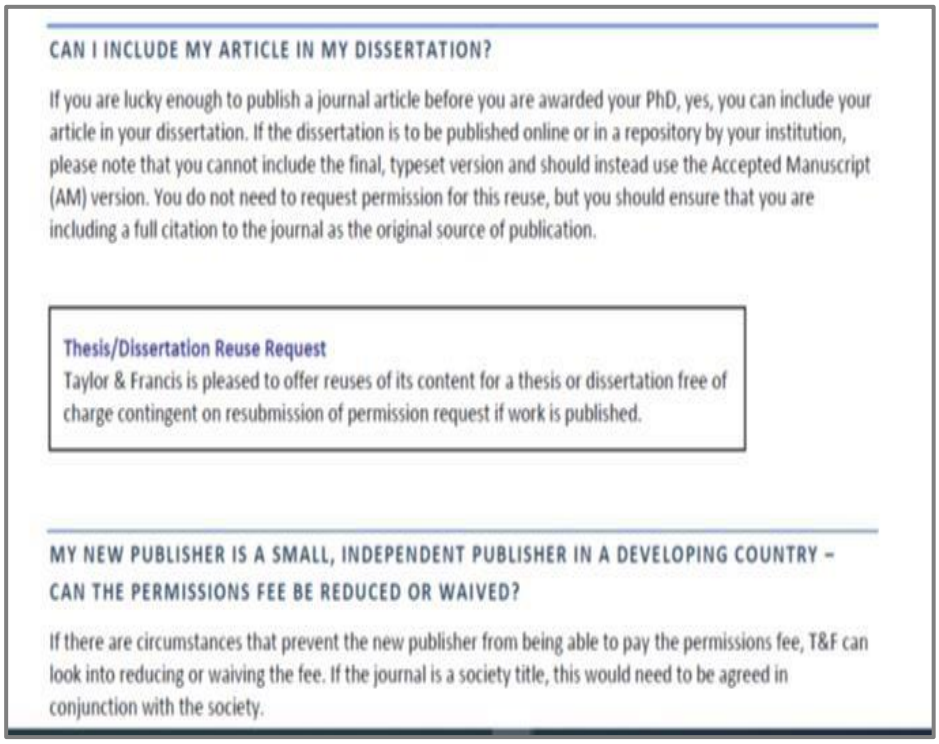
Published online: 06 Feb 2020.

2.2 Copyright permission of the systematic review



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Appendix 3 Appendices for Chapter 3

3.1 Tests for Normality

Injury		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
age	no	0.221	53	0.000	0.836	53	0.000
	yes	0.189	75	0.000	0.822	75	0.000
Body Mass Index	no	0.120	53	0.056	0.960	53	0.074
	yes	0.063	75	.200*	0.980	75	0.270
soccer sessions per week	no	0.259	53	0.000	0.842	53	0.000
	yes	0.281	75	0.000	0.870	75	0.000
TMD	no	0.076	53	.200*	0.985	53	0.742
	yes	0.111	75	0.023	0.955	75	0.010
SHC	no	0.088	53	.200*	0.966	53	0.140
	yes	0.122	75	0.007	0.951	75	0.006
Soccer hours per week	no	0.235	53	0.000	0.842	53	0.000
	yes	0.181	75	0.000	0.939	75	0.001
Play length	no	0.164	53	0.001	0.881	53	0.000
	yes	0.269	75	0.000	0.840	75	0.000

*. This is a lower bound of the true significance. a. Lilliefors Significance Correction

All variables with p values < 0.05 are not normally distributed, but their means or averages will be normally distributed, as long as their sample sizes > 30. However, used the stronger (parametric tests) in our analysis.

Parametric and non-parametric tests for risk factors

	Uninjured	Injured	Independent t- test values	Mann Whitney Test sig
Age: years; Mean ± SD	25.919±8.078	25.166±7.678	0.568	0.599
BMI: kg/m^2; Mean ± SD	24.296±3.970	23.653±4.032	0.339	0.286
Age of puberty: years; Mean ± SD	12.85±1.513	12.57±1.424	0.242	0.42
Score on SHC mean ± SD	5.4±2.6	4.2±3	0.014*	0.017
Play length: mean ± SD years	5.8±4.9	6.6±5.2	0.292	0.40
Soccer duration: mean ± SD hours/week	2.2±1	6.6±5.2	0.45	0.24
Soccer frequency: mean ± SD sessions/week	2.8±1.8	3.1±1.7	0.43	0.215
TMD mean ± SD	103.1±19.0	99.8±17.6	0.28	0.277

Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies

We are seeking amateur female soccer players to take part in this study by completing an online questionnaire.

What is the study about?
This study will explore the general characteristics of amateur female soccer players, including the profile of injury among amateur female soccer players and their perceptions of injury risk factors and prevention strategies.

Who can take part in this study?
Female adult soccer players from teams of the amateur leagues

What will I have to do?
You will be asked to fill out information about yourself as a female player, any soccer injuries you may have experienced, and your opinion on potential causes and prevention strategies of soccer injuries at the amateur level.

Benefits:
The findings will help to build the foundation for a future study aimed at developing an educational program to minimize the rates of injury and support the long and healthy soccer practice of female players. You may contact the researchers for feedback on your questionnaire if you so desire.

Risks:
This is a questionnaire-based study; no risks are anticipated.

What if I do not want to take part?
Taking part in this study is purely voluntary. If you don't want to be in the study, you do not have to. You can choose to stop working on the questions at any time.

What happens to the information?
Information will be stored securely on laptops or in a secure cloud server at the University of Limerick. Only the people running the study will look at this information. After 7 years paper data will be shredded, and electronic data will be electronically deleted from the laptops.

Who else is taking part?
Adult female soccer players from amateur soccer clubs in Munster and possibly beyond.

Where will I have to go?
You will be able to fill in the questionnaire online from your own device.

What happens at the end of the study?
After all of the surveys are collected, we will analyse the data and the main findings will be written up. It is hoped that our results will be published in journals about female sports

and presented at relevant conferences nationally and internationally. Feedback will be delivered to the participants through an e mail to their team's coach.

What if I have more questions or do not understand something?

If you have any questions, you can contact us at the details listed below at any time before, during or following the study.

For further details or if you have any questions regarding the study, please contact:

Co-Investigator

Tahani Alahmad, PhD Student,
School of Allied Health, University of Limerick.
Email: Tahani.alahmad@ul.ie

Principal Investigator

Dr Roisin Cahalan, School of Allied Health, University of Limerick.
Tel: (061) 202959
Email : Roisin.Cahalan@ul.ie

Many thanks

If you have concerns about this study and wish to contact someone independent, you may contact

Chairman Education and Education Sciences Research Ethics Committee
EHS Faculty Office
University of Limerick
Tel (061) 234101
Email: ehsresearchethics@ul.ie

3-2: Participants' consent form EHSREC No: [2019_04_06_EHS]

Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies.

Should you agree to participate in this study please read the statements below and if you agree to them, please sign the consent form.

	YES	**NO**
I have read and understood the information sheet.		
I am fully aware of what I will have to do, and of any risks and benefits associated with the study.		
I know that my participation is voluntary and that I can withdraw from the project at any stage without giving any reason. My data can be withdrawn at any stage up until the commencement of analysis.		
I agree to participate in this study.		
I agree that data resulting from my participation in this study may be used in future studies on injury in amateur female soccer players.		
I am happy to be kept informed of any related research projects		

Volunteer name (Block Capitals): _____

Signature: _____ Date: _____

Investigator's Signature _____ Date: _____

THANK YOU

https://www.surveymonkey.com/r/XNDRHBP

Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies.

Dear Player,

In this study, we are aiming to explore the profile and injury history of amateur female soccer players in Ireland, as well as their knowledge regarding the potential risk factors of injuries and prevention strategies used in soccer. The following questionnaire will ask a number of questions in relations to:

- Yourself as a female player.
- Any previous soccer injuries.
- Your opinion on the potential causes of, and prevention strategies for injury.

Results of the study will be used to develop education programmes to minimize injury risk in the women's game

The questionnaire should take you no longer than 15 minutes. Please answer every question.

If you have any further questions, please contact:
Mrs. Tahani Alahmad,
Email: Tahani. Alahmad@ul.ie
PhD candidate, School of Allied Health

University of Limerick

https://www.surveymonkey.com/r/XNDRHBP

Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies.

Part 1:

I. General information:

1. Name…….

(For the following questions, answers will be available through drop down menus)

2. Date of birth: Day/ Month/ Year.
3. Weight (use your preferred measure and select 'Not applicable' for the other measure):

Kilogram: □ Not applicable, □ 35……□ 120, Stones: □ Not applicable, □ 5.5……□ 18.8, Pounds: □ Not applicable, □ 1……□ 14

4. Height (use your preferred measure and select 'Not applicable' for the other measure):

Meters: □ Not applicable, □ 1.40……□ 2.20, Foot: □ Not applicable, □ 4.5……□ 7.2, Inch: □ Not applicable, □ 1……□ 12

5. Team/ league: Please name

II. **Player information:** Please answer the following questions:

1. How long have you been playing at this level (in years)?

   □ 0, □ 1, □ 2, □ 3 ……. □ 25.

2. What position do play in most often?

   □ Defender □ Forward □ Attacking midfielder □ Defending midfielder □ Central midfielder □ Goal keeper.

3. Do you play in another position? □ Yes □ No (if your answer is 'No' go to III)
4. What is this position?

□ Defender □ Forward □ Attacking midfielder □ Defending midfielder

□ Central midfielder □ Goal keeper □ Not applicable

III. **Female hormones:** Please answer the following questions:

1. Are you presently taking any female hormones (estrogen, progesterone, birth control pills)? □ Yes □ No
2. Have you ever had a menstrual period? □ Yes, □ No If your answer is 'No' please go to IV)
3. How old were you when you had your first menstrual period? □ 8 years ……, □ 20 years
4. How many periods have you had in the last 12 months? □ 0……., □ 24

IV. Joint hypermobility: Note which of these movements/joint positions you can make. Please refer to each side of the body.

I can bend my little finger backwards more than 90 degrees (as in picture 1)		
 **1**	□ Right	□ Left
	□ Yes □ No	□ Yes □ No
I can bend my thumb until it almost reaches my forearm (as in picture 2)		
 **2**	□ Right	□ Left
	□ Yes □ No	□ Yes □ No
I can over stretch my elbow more than 10 degrees (as in picture 3)		
 **3**	□ Right	□ Left
	□ Yes □ No	□ Yes □ No
I can overstretch my knee (as in picture 4)		
	□ Right	□ Left

 **4**	□ Yes □ No	□ Yes □ No
I can bend my body and lay on my hands (as in picture 5)		
 **5**	□ Yes □ No	

V. Mood: Below is a list of words that describe feelings people have. Please mark the number that best describes how you feel right now**.**

	Not at all	A little	Moderately	Quite a lot	Extremely
Tense	0	1	2	3	4
Angry	0	1	2	3	4
Worn out	0	1	2	3	4
Unhappy	0	1	2	3	4
Proud	0	1	2	3	4
Lively	0	1	2	3	4
Confused	0	1	2	3	4
Sad	0	1	2	3	4
Active	0	1	2	3	4
On-edge	0	1	2	3	4
Grouchy	0	1	2	3	4
Ashamed	0	1	2	3	4
Energetic	0	1	2	3	4
Hopeless	0	1	2	3	4

Uneasy	0	1	2	3	4
Restless	0	1	2	3	4
Unable to concentrate	0	1	2	3	4
Fatigued	0	1	2	3	4
Competent	0	1	2	3	4
Annoyed	0	1	2	3	4
Discouraged	0	1	2	3	4
Resentful	0	1	2	3	4
Nervous	0	1	2	3	4
Miserable	0	1	2	3	4
Confident	0	1	2	3	4
Bitter	0	1	2	3	4
Exhausted	0	1	2	3	4
Anxious	0	1	2	3	4
Helpless	0	1	2	3	4
Weary	0	1	2	3	4
Satisfied	0	1	2	3	4
Bewildered	0	1	2	3	4
Furious	0	1	2	3	4
Full of pep	0	1	2	3	4
Worthless	0	1	2	3	4
Forgetful	0	1	2	3	4
Vigorous	0	1	2	3	4

Uncertain about things	0	1	2	3	4
Bushed	0	1	2	3	4
Embarrassed	0	1	2	3	4

I. **Sport Competition Anxiety Test:** Read each statement below, decide if you "Rarely", "Sometimes" or "Often" feel this way when competing in your sport (soccer), tick the appropriate box to indicate your response.

		Rarely	Sometimes	Often
1	Competing against others is socially enjoyable			
2	Before I compete, I feel uneasy			
3	Before I compete, I worry about not performing well			
4	I am a good sportsperson when I compete			
5	When I compete, I worry about making mistakes			
6	Before I compete, I am calm			
7	Setting a goal is important when competing			
8	Before I compete, I get a queasy feeling in my stomach			
9	Just before competing, I notice my heart beats faster than usual			
10	I like to compete in games that demand a lot of physical energy			
11	Before I compete, I feel relaxed			
12	Before I compete, I am nervous			
13	Team sports are more exciting than individual sports			
14	I get nervous wanting to start the game			
15	Before I compete, I usually get uptight			

II. **Subjective health complaints:**

Please tick for each item, how it has affected you during the past two weeks.

Item	Not at all	A little	Some	Sever
Palpation/extra heartbeats				
Chest pain				
Breathing difficulties				
Heartburn				
Stomach discomfort				
Diarrhoea				
Constipation				
Eczema				
Tiredness				
Dizziness				
Anxiety				
Sadness/depression				
Sleep problems				

III. Athlete Sleep Screening Questionnaire (ASSQ):

The following questions relates to your sleep habits. Please select the best answer which you think presents your typical sleep habits over the recent past. For all questions select the most appropriate answer for each statement below.

1. During the recent past, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed)
    a. 5 to 6 hours.
    b. 6 to 7 hours.
    c. 7 to 8 hours.
    d. 8 to 9 hours.
    e. More than 9 hours.
2. How many naps per week do you take?
    a. None.
    b. Once or twice.
    c. Three or four times.
    d. Five to seven times.
3. How satisfied/dissatisfied are you with the quality of your sleep?
    a. Very satisfied.
    b. Somewhat satisfied.
    c. Neither satisfied nor dissatisfied.
    d. Somewhat satisfied.
    e. Very dissatisfied.
4. During the recent past, how long has it usually takes you to fall a sleep each night?
    a. 15 minutes or less.
    b. 16-30 minutes.
    c. 31-60 minutes.
    d. Longer than 60 minutes.
5. How often do you have trouble staying asleep?
    a. None.
    b. Once or twice per week.
    c. Three or four times per week.
    d. Five to seven days per week.

IV. Training load:

During a typical training week in the last competitive season, what is?

I. The total **number of physical activity sessions** that you performed.

No. of sessions	Type of activity
0	Soccer
1	Strength training
2	Camogie
3	Gaelic handball
4	Rugby
5	Gym based activities
6	Sports dance
7	Golf
8	Hockey
9	Others (please specify)
10	
.	
50	

II. The total **number of hours** that you spent in physical activity.

No. of hours	Type of activity
0	Soccer
1	Strength training
2	Camogie
3	Gaelic handball
4	Rugby
5	Gym based activities
6	Sports dance
7	Golf
8	Hockey
9	Others (please specify)
10	
.	
50	

III. How do you **describe your effort** (rating of perceived exertion 'RPE') during physical activity sessions? The scale is 0-10 (0 = No activity…. 10 = Maximal effort)

RPE	Type
0	Soccer
1	Strength training
2	Camogie
3	Gaelic handball

4	Rugby
5	Gym based activities
6	Sports dance
7	Golf
8	Hockey
9	Others (please specify)
10	

Part 2. Your soccer- related injuries

I. Did you sustain any injury/injuries during a soccer match or soccer training session that caused you to miss one or more days of play during your competitive season, if your answer is 'No', please go to part 3. □Yes, □No

II. Please select the answer that describes your injury from the table below.

	Body part	Body side	Injured structure/type of injury	Days lost	New/ recurrent	During	Physical contact
	Wrist/ hand/fingers	Right	Bone	1	New	Match	Yes/ with another player
	Elbow/Forearm	Left	Muscle		Recurrent	Training	Yes/ with an object
	Upper arm	Both	Ligament	2	Unknown	Do not remember	NO
	Shoulder, Clavicle	Central	Tendon	3			Do not remember
	Head, face	Unknown	Joint	4			
	Neck		Fascia	5			
	Upper back		Cuts/ lacerations	6			
	Chest		Bruising, Haematoma, dead leg	7			
	Mid back		Concussion	8			

	Lower back		Un known	9			
	Pelvis		Others (specify)……	10			
	Groin		……..	11			
	Anterior thigh			12			
	Posterior thigh			13			
	Knee			14			
	Shin			15			
	Calf			16			
	Ankle			17			
	Foot			18			
	Others: (specify)…… ……			.			
				.			
				40			
				Do not remember			

Injury no.2							

Part 3: Player's knowledge and opinion

1.Potential causes of injury.

Which of the following factors do you believe will increase your chance of injury during a soccer match or training session?

No	Factor	Strongly increases the risk	Increases the risk	Does not affect the risk	Decreases the risk	Strongly decreases the risk
1	Fitness deficits.					
2	Coordination deficit.					
3	Fatigue/Exhaustion.					
4	Concentration or attention deficit.					
5	Extreme weather conditions.					
6	Decreased balance.					
7	Increased playing/ training time.					
8	Increased body mass index (weight).					
9	Not wearing a protective device or tape.					
10	Wearing low quality shoes.					
11	The position in which you are playing (e.g., defenders, strikers).					
12	Inadequately treated previous injury in the same body part.					

13	Inadequately treated previous injury in different body part.					
14	Increased mobility in your joints (more than normal).					
15	Unequal muscle strength in the lower limbs.					
16	Using oral contraceptives.					
17	Playing during your menstruation period.					
18	Older age.					
19	Younger age.					
20	Decreased or low-quality sleep.					
21	The quality of diet.					
22	Health complaints (e.g., headache, dizziness, stomach discomfort……)					
23	Playing surface: natural grass versus artificial turf.					
24	Other: (please mention) …….					

I. Education on preventive strategies:

1. When was the last time you received education on how to reduce your risk of getting injured? If your answer is "Never" please go to III.
   □ Never □ Just before this season, □ During this season, □ This year, □ Last year, □ Last few years, □ Do not remember.

2. Who delivered this education? □ A physiotherapist □ The coach □ Self education □ Other (specify)…
3. What was the format of this education? □ Workshop □ Online □ Leaflet □ One to one □ other (specify) ……
4. Do you feel sufficiently informed about the application and effectiveness of preventive measures for avoiding injuries in soccer? □ Yes □ No □ Undecided

II. Prevention strategies:

Which of the following methods do you believe will decrease the chance of injury during a soccer match or training session?

No.	Prevention method	Strongly prevents injury	Prevents injury	Does not affect injury	Increases injury	Strongly increases injury
1	Extra stretching.					
2	Specialized strength training.					
3	To know more about the causes of injury.					
4	Increased fitness.					
5	Increased agility.					
6	Increase soccer-specific skills					
7	Balance training.					
8	Adequate warm up.					
9	Adequate cool down.					
10	Keep hydrated.					
11	Taping (Kinesiotaping, stabilizing Taping).					
12	Suitable footwear or orthotic.					
13	Use of protective equipment (e.g., shin guard or corset).					
14	Protective clothing for weather conditions.					
15	Management of psychological stress.					
16	Management of anxiety.					

17	Preseason screening.					
18	Adequate rest and recovery.					
19	Avoiding unnecessary physical contact with other players.					
20	Increased concentration.					
21	Good playing techniques.					
22	Taking precautions during menstruation.					
23	Avoiding early return to soccer before medical advice.					
24	Using both legs equally for kicking and receiving.					
25	Other: (please mention) …….					

Thank you …

3.1 The email to the team's coach EHSREC No: [2019_04_06_EHS]

Injury in adult female soccer players

Dear Team Coach

I hope this email finds you well.

I am a Ph.D. student interested in sports injury prevention in amateur female soccer players. I request your kind assistance in a survey study 'Injury in adult female soccer players' among active top-level players in your team (see the attached information sheet).

I would be grateful if you could explain the study to your active players and, arrange a meeting for me with them. This meeting is to explain the study, answer any questions regarding participation and to obtain players' signed approval of participation.

Thank you for considering my request. Your early response would be appreciated.

Please do not hesitate to contact me for further information.

Kind regards

Tahani Alahmad: Tahani.Alahmad@ul.ie

BSc, MSc, SPhD student, Physiotherapy, School of Allied Health, University of Limerick, Ireland

3.5 Research Output (Manuscript of the cross-sectional study)

Physical Therapy in Sport 50 (2021) 184–194

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Injury risk profile of amateur Irish women soccer players and players' opinions on risk factors and prevention strategies

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ABSTRACT

Objective: To explore injury profile, opinions on risk factors and injury prevention, among Irish amateur women soccer players.
Design: A cross-sectional online survey. *Setting:* Irish amateur winter league.
Participants: Active players ≤18 years of age.
Main outcomes: Differences were found between injured and uninjured groups, and risk factors that significantly predict soccer injury were identified.
Results: 168 injuries were reported by 83 respondents during the winter season. An increased prevalence of competition anxiety was observed in (53.8%;n − 85 of respondents) compared to other risk factors. There was a negative association between injuries and players' general health state (OR − 0.820, 95% CI 0.7–0.9, p − 0.007). Players' knowledge about some risk factors including playing position, joint hypermobility, and playing during menses contradicts current evidence. 50%; n − 67 of the respondents had not received any education on injury risk or prevention.
Conclusion: This study identified that Irish amateur women soccer players that responded have different characteristics, prevalence of risk factors and injury profiles to women players from different levels and countries. The findings suggest that some players may not be aware of the existing evidence base pertaining to common risk factors for injury. Further research is required to confirm the findings and explore the implementation of injury prevention strategies.

1. Introduction

Women's participation in soccer has become increasingly popular (Ruiz-Esteban, Olmedilla, Méndez, & Tobal, 2020) over the last decade, with approximately 30 million players worldwide (Del Coso, Herrero, & Salinero, 2016). In Ireland, the number of registered players in women's soccer leagues increased almost 100% between 2000 and 2006 (Liston, 2006). However, despite this increasing participation, research exploring injury risk among this cohort is scarce (Sentsomedi & Pudcree, 2016). Lately, the changes in the social perspective towards gender differences increases the interest in female soccer (Ruiz-Esteban et al., 2020). Importantly, findings from studies involving males cannot be generalised to females (Altavilla, Di Tore, Riela, & D'Isanto, 2017; Pedersen, Aksdal, & Stalsberg, 2019), as they exhibit differences in performance, responses, and fatigability (Altavilla et al., 2017). Female players were found to perform at a slower speed, cover shorter total distances, and exhibit earlier fatigue and decreased performance later in the

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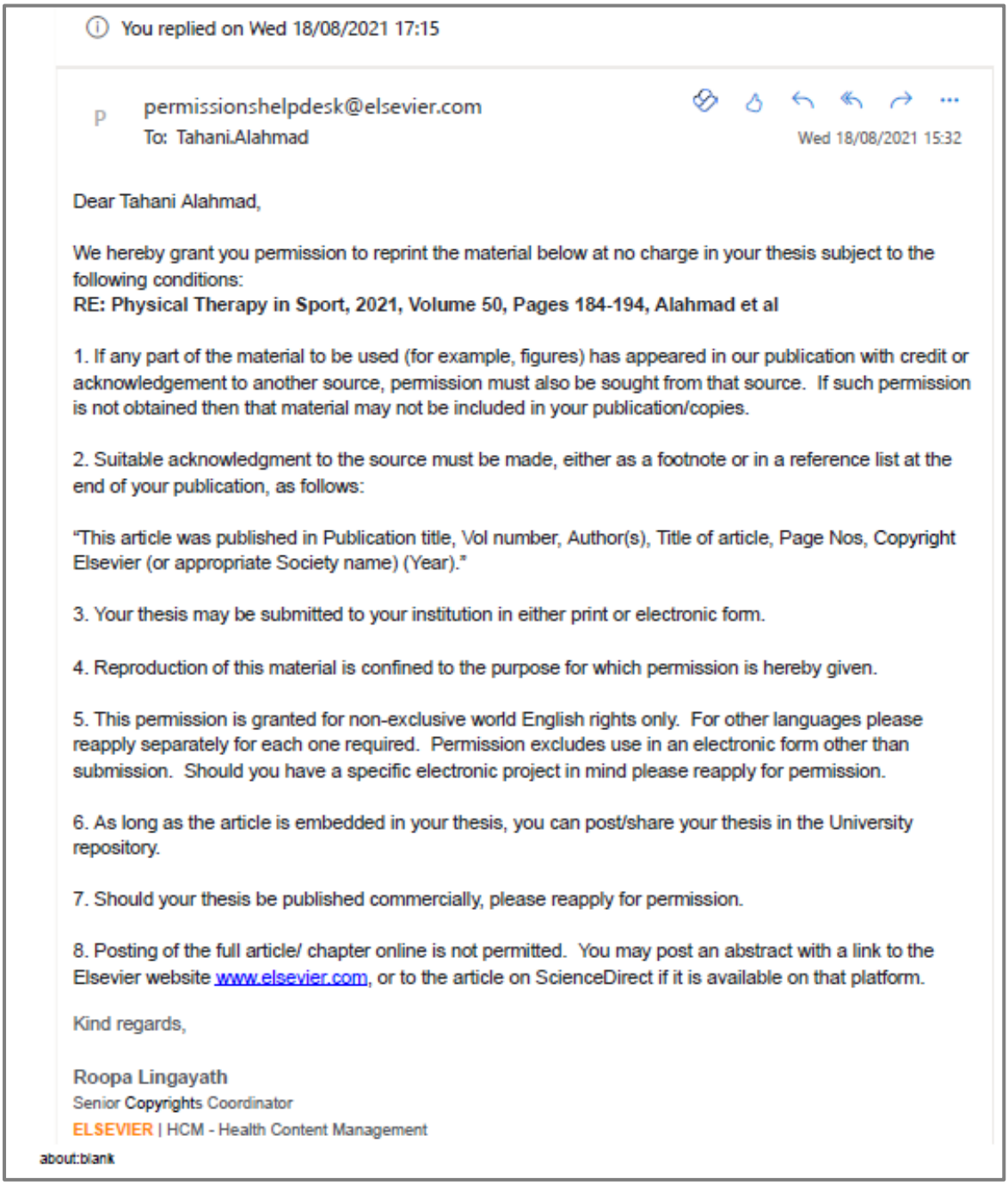

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Appendices for Chapter 4

4.1: Participants' information sheet EHSREC No: [2020_06_18]

Injury risk and prevention strategies among Saudi and Irish amateur women soccer players – A qualitative study

We are seeking adult amateur female soccer players to take part in this study through an online Skype audio interview

What is the study about?
This study aims at exploring the opinions of adult Irish female soccer players about injury causes and what prevention strategies they are using, as well as the possible barriers and facilitators to using these prevention strategies.

Who can take part in this study?
Adult female soccer players from teams of Irish amateur leagues

What will I have to do?
You just have to share your experience and opinions about risk and prevention of soccer injuries by answering few questions during an online interview.

Benefits:
This study will provide a clearer understanding of the perception about risk factors and prevention strategies, as well as the uptake of prevention strategies among adult female soccer players. Given the paucity of information in this area, new knowledge will help to improve the understanding and this management of injury in the women's game. Findings from this study will inform future injury prevention programs and decrease the negative impact of soccer injuries among female players.

After completing the interview, you will be given the chance to enter in a draw for a €150 Amazon gift card "one for all".

Risks:
No risks anticipated from this study.

What if I do not want to take part?
Taking part in this study is purely voluntary. If you don't want to be in the study, you do not have to. You can choose to quit at any time.

What happens to the information?

Information will be stored securely on research teams' laptops. Only the people running the study will look at this information. After 7 years paper data will be shredded, and electronic data will be electronically deleted from the research teams' laptops.

Who else is taking part?

Adult female soccer players from amateur soccer clubs in Ireland.

Where will I have to go?

You will be interviewed online through your own device.

What happens at the end of the study?

After all of the interviews completed, we will analyse the data and the main findings will be written up. It is hoped that our results will be published in journals about female sports and presented at relevant conferences nationally and internationally. If you are interested in the findings of this study? We invite you to inform the Co-investigator (TA) during the interview, and you will receive a summary of findings after completion of the study.

For further details or if you have any questions regarding the study, please contact:

Co-Investigators

Tahani Alahmad, PhD Student,
School of Allied Health, University of Limerick.
Email: Tahani.alahmad@ul.ie
Dr. Audrey Tierney, School of Allied Health, University of Limerick.
Email: Audrey.Tierney@ul.ie

Principal Investigator

Dr Amanda Clifford, School of Allied Health, University of Limerick.
Email: Amanda.Clifford@ul.ie

Many thanks

If you have concerns about this study and wish to contact someone independent, you may contact

Chair Education and Education Sciences Research Ethics Committee
EHS Faculty Office
University of Limerick
Tel (061) 234101
Email: ehsresearchethics@ul.ie

4.2: Participants' consent form EHSREC No: [2020_06_18]

Injury risk and prevention strategies among Saudi and Irish amateur women soccer players – A qualitative study

Should you agree to participate in this study please read the statements below and if you agree to them, please sign the consent form.

- I have read and understood the participant information sheet.
- I understand what the project is about, and what the results will be used for.
- I understand that what the researchers find out in this study may be shared with others but that my name will not be given to anyone in any written material developed.
- I am fully aware of what I will have to do, and of any risks and benefits of the study.
- I know that I am choosing to take part in the study and that I can stop taking part in the study at any stage without giving any reason to the researchers.

This study involves audio recording of the interview using Skype. Please tick the appropriate box

- I am aware that my participation in this study may be recorded (audio) and I agree to this. However, if I feel uncomfortable at any time, I can ask that the recording equipment be switched off. I understand that I can ask for a copy of my recording. I understand what will happen to the recordings once the study is finished.

If you agree to the above and wish to take part in the study, you will be asked to state the following sentence which will be audio recorded:
"I agree to the statements in the consent form, and I consent to taking part in this research study".
For investigator use only:
Participant name (please print): _____
Date consent obtained: _____
Investigator's signature: _____ Date: _____

Injury risk and prevention strategies among Saudi and Irish amateur women soccer players – A qualitative study

Participants' name:		Age:	Playing position:	
Start time:	End time:		Day/Date:	
Did you sustain an injury?	When was that?	Which location?	What type?	How many days lost?

Introduction script

Thank you for agreeing to take a part in this interview. This interview will last for **30-45** min. This interview is completely confidential and only the research team have access to the contents. There is no right or wrong answer for these questions; the aim is to get your experience and opinions about risk factors for injury, and prevention measures to avoid injury. If any question is unclear, please don't hesitate to ask for further clarification.

Before we start, can I have your permission to start the audio recording? ☐

Do you agree with the following statement? ☐

"I agree to the statements in the consent form, and I consent to taking part in this research study".

Questions:

Sections		Questions
A- Players' opinions about potential causes of their injury	1	Let's talk about your injury experience, tell me what you think caused your injury any factors on the same day or before)
	2	Do you think there are key causes of soccer injury in women players only? Any other causes? (Menses, anxiety)
B- Perception and implementation of preventive measures before/during the game	1	What do you think about preseason screening programs to identify players at risk of injury? Do your team have a preseason-screening programme? Till me about it.
	2	Can you describe your warm up routine with your team? Type of exercises, time, do you follow a routine?
	3	In your opinion, what were the advantages of warm up exercises in decreasing the chance of injury?
	4	Do you and your team perform a cool down routine after the game? Tell me about it: type of exercises, time, do you follow a routine? Do you think they are effective in preventing injury? How?
	5	What do you think about the recovery period between the games? Was an adequate recovery period applied in your team? Length of recovery period?
	6	Before the competition game, how do you prepare yourself for the game to decrease the chance of in-game injuries as a female player?
	7	What do you do to decrease the chance of injuries during the game? For example, to avoid injury in areas of the pitch that involves more aggressive e of play (close to the goal)?
	8	Are there any other preventive measures before /during games that you use? Why?
	9	What do you think about players' education about injury risk and prevention?
	10	How do you think education about injury prevention could be tailored (more applicable) to women players? OR What women players need to know to prevent injuries?

C- Barriers/ facilitators of proper implementation of preventive measures	1	What, in your opinion, are the obstacles to implementing injury prevention programs among Irish (Saudi) amateur women soccer players in general, are there particular barriers that limit your application of injury prevention measures? How did they affect your implementation of prevention
	2	What are the key things that help /increase the implementation of injury prevention programs among Irish (Saudi) amateur women soccer players in general? What are the key things that help you to apply/follow injury prevention measures? How can they help/increase your implementation of injury prevention
	3	Is there anything you want to add?

4.4: Participants' invitation email EHSREC No : [2020_06_18]

Participant' invitation email

Email title: invitation to participate in a study, and a chance to win €150 Amazon gift card.

Dear soccer player

I hope you are well and thank you for taking the time to read this email.

We are working on a PhD project to explore injury prevention among women soccer players. Our previous study 'Injuries in adult female soccer players' reported increased rate of soccer injuries among Irish amateur women players compared to their peers from other countries. Half of the respondents of the survey had not received any education about injury prevention, which has been shown to reduce the risk of injury.

So, we are planning to conduct a study to explore players' opinions about risk factors for injury and prevention strategies among Irish amateur soccer players. The study will be conducted through a 30-45 min Skype audio interview (see the attached information sheet).

This study was approved by the Faculty of Education and Health Sciences Research Ethics Committee at the University of Limerick [2020-06-18- EHS] and is under the supervision of Dr. Amanda Clifford and Dr. Audrey Tierney.

This study will provide crucial insights into injury experience and knowledge in your community.

By completion of the interview, you will have the opportunity to be entered into a draw for a €150 Amazon card.

If you are interested in taking part or require further information, please do not hesitate to contact me on my email: tahani.alahmad@ul.ie.

Your participation is completely voluntary, and all of your responses will be anonymous and confidential.

If you agree to participate, please provide your contact details and the appropriate time to contact you.

Kindly read the attached consent form and note that providing your contact details will be considered as your kind approval for me to contact you.

Looking forward to hearing from you soon.

Best Wishes,

Tahani Alahmad

4.5: Letter to FAI EHSREC No: [2020_06_18]

To whom it my concern in the Irish Women's Football Committee

Dear Sir/Madam

I hope this letter finds you well.

We are working on a PhD research project to explore injury prevention among Irish amateur women soccer players, and we are contacting you to seek your assistance in encouraging participation in this project.

Female participation in soccer has been increasing worldwide, with a parallel increase in injury, which impacts on club and player well-being. To date, no study has explored risk factors for injury in adult female amateur teams in Ireland, and the findings from male counterparts cannot be generalized.

We are requesting your kind assistance to increase participation of female soccer players of 18 years or older from amateur teams in this study (Injury Risk and Prevention Strategies in Adult Female Soccer Players – a qualitative study of experiences and perceptions) through online audio interviews, see the attached information sheet.

This study is conducted by a PhD student from the School of Allied Health and approved by the ethics committee of the Health and Education Faculty in the University of Limerick [2020-06-18- EHS].

A suggested plan is to add an invitation to the FAI web page to ensure higher visibility, and if possible, provide a supporting letter from the FAI that could be attached to the invitation emails to the team coaches. It is worthy to mention that participants who complete the interview will be given the chance to enter in a draw for a €150 Amazon gift card "one for all".

Information from this study is crucial to develop effective injury prevention programs tailored to female players to support professional well-being in this group.

Your cooperation is key to this study's success

For any further information, please do not hesitate to contact

The primary investigator Dr. Amanda Clifford: Amanda.Clifford@ul.ie

Co-investigator Tahani Alahmad: tahani.alahmad@ul.ie

Kind regards

4.6: Participants' Consent Form (Saudi)

رقم الصادر: ٤٠٩٩
بتاريخ: ٢٠٢٠/١٢/٢٤

استراتيجيات الوقاية والمخاطر من الإصابة لدى لاعبات كرة القدم السعوديات و الايرلنيات - دراسة نوعية

نحن نبحث عن لاعبات كرة قدم هواة راشدات للمشاركة في هذه الدراسة من خلال مقابلة صوتية عبر برنامج Zoom

ما هي اهداف الدراسة؟

تهدف هذه الدراسة إلى استكشاف آراء لاعبات كرة القدم السعوديات البالغات حول أسباب الإصابة واستراتيجيات الوقاية التي يستخدمنها ، بالإضافة إلى العوائق والميسرات المحتملة لاستخدام استراتيجيات الوقاية هذه.

من يمكنه المشاركة في هذه الدراسة؟

لاعبات كرة القدم البالغات من فرق بطولات الدوري الأيرلندية للهواة.

ما الذي يجب علي فعله؟

عليك فقط مشاركة تجربتك وآرائك حول المخاطر والوقاية من إصابات كرة القدم من خلال الإجابة على بعض الأسئلة خلال مقابلة عبر الإنترنت.

ماهي فوائد الدراسة:

ستوفر هذه الدراسة فهماً أوضح للتصور حول عوامل الخطر واستراتيجيات الوقاية ، فضلاً عن استيعاب لاعبي كرة القدم البالغات لاستراتيجيات الوقاية. نظرًا لندرة المعلومات في هذا المجال ، ستساعد المعرفة الجديدة على تحسين فهم وإدارة الإصابة في لعبة السيدات. النتائج من هذه الدراسة ستفيد برامج الوقاية من الإصابات في المستقبل وتقلل من التأثير السلبي لإصابات كرة القدم بين اللاعبات.

هل هناك مخاطر من المشاركة:

لا توجد مخاطر متوقعة من هذه الدراسة.

ماذا لو لم أرغب في المشاركة؟

المشاركة في هذه الدراسة تطوعية بحتة. إذا كنت لا تريد أن تكون في الدراسة ، فلا داعي لذلك. يمكنك اختيار الإقلاع عن التدخين في أي وقت.

ماذا يحدث للمعلومات؟

سيتم تخزين المعلومات بشكل آمن على أجهزة الكمبيوتر المحمولة لفرق البحث. فقط الأشخاص الذين يديرون الدراسة سوف ينظرون إلى هذه المعلومات. بعد ٧ سنوات ، سيتم تمزيق البيانات الورقية وسيتم حذف البيانات الإلكترونية إلكترونيًا من أجهزة الكمبيوتر المحمولة لفرق البحث.

من يمكنه المشاركه أيضا؟

لاعبات كرة القدم البالغات من نوادي كرة القدم للهواة في السعودية.

أين ستكون المشاركة؟

ستتم مقابلتك عبر الإنترنت من خلال جهازك الخاص.

ماذا يحدث في نهاية الدراسة؟

بعد الانتهاء من جميع المقابلات ، سنقوم بتحليل البيانات وسيتم كتابة النتائج الرئيسية. ومن المؤمل أن يتم نشر نتائجنا في مجلات حول الرياضة النسائية وتقديمها في المؤتمرات ذات الصلة على الصعيدين الوطني والدولي. إذا كنت مهتمًا بنتائج هذه الدراسة؟ ندعوك لإبلاغ الباحثة (ت.أ) أثناء المقابلة ، وستتلقى ملخصًا للنتائج بعد الانتهاء من الدراسة.

لمزيد من التفاصيل أو إذا كان لديك أي أسئلة بخصوص الدراسة ، يرجى الاتصال بـ:

الباحثين المشاركين:

تهاني الأحمد طالبة دكتوراه
كلية الصحة المتحالفة ، جامعة ليمريك.
بريد إلكتروني: Tahani.alahmad@ul.ie
الدكتورة أودري تيرني ، كلية الصحة المتحالفة ، جامعة ليمريك.
البريد الإلكتروني: Audrey.Tierney@ul.ie
الباحث الرئيسي:
أماندا كليفورد ، كلية الصحة المتحالفة ، جامعة ليمريك.
البريد الإلكتروني: Amanda.Clifford@ul.ie

شكرا جزيلا لتعاونكم

إذا كانت لديك مخاوف بشأن هذه الدراسة وترغب في الاتصال بشخص مستقل ، فيمكنك الاتصال اللجنة الطبية في الاتحاد السعودي لكرة القدم
البريد الالكتروني:med@staff.com.sa

4.7: Participants' consent form (Saudi)

رقم الصادر: ٤٠٩٩
بتاريخ: ٢٠٢٠/١٢/٢٤

استراتيجيات الوقاية والمخاطر من الإصابة لدى لاعبات كرة القدم السعوديات و الايرلنيات - دراسة نوعية

في حالة موافقتك على المشاركة في هذه الدراسة ، يرجى قراءة البيانات أدناه ،و التوقيع على نموذج الموافقة.

- لقد قرأت وفهمت ورقة معلومات المشارك.
- أفهم ما هو المشروع ، والنتائج التي سيتم استخدامها.
- أفهم أن ما اكتشفه الباحثون في هذه الدراسة قد يتم مشاركته مع آخرين ولكن لن يتم إعطاء اسمي لأي شخص في أي مادة مكتوبة تم تطويرها.
- إنني على دراية كاملة بما يجب أن أفعله ، وأي مخاطر وفوائد للدراسة.
- أعلم أنني أختار المشاركة في الدراسة وأنه يمكنني التوقف عن المشاركة في الدراسة في أي مرحلة دون إبداء أي سبب للباحثين.

تتضمن هذه الدراسة التسجيل الصوتي للمقابلة باستخدام برنامج Zoom. الرجاء اختيار الخانة المناسبة:

- أدرك أن مشاركتي في هذه الدراسة قد يتم تسجيلها (صوتي) وأوافق على ذلك. ومع ذلك ، إذا شعرت بعدم الارتياح في أي وقت يمكنني أن أطلب إيقاف تشغيل جهاز التسجيل. أفهم أنه يمكنني طلب نسخة من التسجيل الخاص بي. أفهم ما سيحدث للتسجيلات بمجرد الانتهاء من الدراسة.

إذا وافقت على ما ورد أعلاه وترغب في المشاركة في الدراسة ، فسيُطلب منك ذكر الجملة التالية التي سيتم تسجيلها صوتيًا:

"أوافق على الإقرارات الواردة في نموذج الموافقة وأوافق على المشاركة في هذه الدراسة البحثية."

لاستخدام الباحث فقط:

اسم المشارك (يرجى طباعته)_____ :

تاريخ الحصول على الموافقة_____ :

توقيع الباحث: _____ التاريخ_____ :

4.8: Approval of study 3 by the ethical committee in the Saudi Arabian Football Federation

صادر : 4099
التاريخ : 2020/12/24
المرفقات : لا يوجد

UNIVERSITY OF LIMERICK

To The Head Of The Medical Committee In The Saudi Arabian Football Federation

Dear Sir

I hope this letter finds you well.

We are working on a PhD research project to explore injury prevention among women soccer players. We are contacting you to seek your approval to conduct this study among Saudi women players, and your kind assistance in encouraging participation in this project.

Female participation in soccer has been increasing worldwide, with a parallel increase in injury, which impacts on club and player well-being. To date, no study has explored risk factors for injury in women soccer teams in Saudi Arabia, and the findings from male counterparts cannot be generalized.

We are requesting your kind assistance to encourage participation of women soccer players (18 years or older) in this study (Injury Risk and Prevention Strategies in Adult Female Soccer Players – a qualitative study of experiences and perceptions) through online audio interviews, see the attached information sheet.

This study is a part of a larger transcultural comperative study which will be conducted by a PhD student from the School of Allied Health in the University of Limerick, Ireland. The Irish part of the comparative study was approved by the ethics committee of the Health and Education Faculty in the University of Limerick [2020-06-18- EHS].

Information from this study are crucial to develop effective injury prevention programs tailored to female players to support professional well-being in this group. Tailored prevention programs are particularly important for Saudi female soccer players who giving their recent entry to the field.

Your cooperation is key to this study's success.

For any further information, please do not hesitate to contact

The primary investigator Dr. Amanda Clifford: Amanda.Clifford@ul.ie

Co-investigators: Tahani Alahmad: Tahani.Alahmad@ul.ie, Dr.Audrey Tierney: Audrey.Tierney@ul.ie

Kind regards

Request is approved.

Khaled S. Alobathani
Executive secretary
Med. Committee, SAFF
24 Dec. 2020

To: Women's Football team Dept.

I have no objection.

General Secretary
Ibrahim S. Alkassim

24-12-2020

4-9: The 15- Point checklist pf criteria for good thematic analysis

Table 2: A 15-Point Checklist of Criteria for Good Thematic Analysis

Process	No.	Criteria
Transcription	1	The data have been transcribed to an appropriate level of detail, and the transcripts have been checked against the tapes for 'accuracy'.
Coding	2	Each data item has been given equal attention in the coding process.
	3	Themes have not been generated from a few vivid examples (an anecdotal approach), but instead the coding process has been thorough, inclusive and comprehensive.
	4	All relevant extracts for all each theme have been collated.
	5	Themes have been checked against each other and back to the original data set.
	6	Themes are internally coherent, consistent, and distinctive.
Analysis	7	Data have been analysed – interpreted, made sense of – rather than just paraphrased or described.
	8	Analysis and data match each other – the extracts illustrate the analytic claims.
	9	Analysis tells a convincing and well-organised story about the data and topic.
	10	A good balance between analytic narrative and illustrative extracts is provided.
Overall	11	Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over-lightly.
Written report	12	The assumptions about, and specific approach to, thematic analysis are clearly explicated.
	13	There is a good fit between what you claim you do, and what you show you have done – i.e., described method and reported analysis are consistent.
	14	The language and concepts used in the report are consistent with the epistemological position of the analysis.
	15	The researcher is positioned as *active* in the research process; themes do not just 'emerge'.