Review Article

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Injuries in Elite Female Soccer Players: An International Systematic Review

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ABSTRACT

Background and Study Aims: There are no articles that cover this subject in full, most focus on a single type of injury. The aim of this study is to summarize elite female soccer players injuries risk factors at 360°.

Methods: We used two database: PubMed and Google Scholar. We engaged only studies who discussed about over 18 years old professional football players. Two reviewers independently assessed articles for eligibility. The CASP checklist was used for quality assessment of included studies.

Results: At the end of our research, we selected 7 articles, who treat about many risk factors in professional female soccer players, intrinsic and extrinsic factors included.

Conclusion: Injury risk factor in elite female soccer players is multifactor related, tricky and intrinsic and extrinsic factors associated. We need others high quality surveys to investigate every risk factor, in order to obtain a good injury screening.

Abbreviations: ACL: Anterior Cruciate Ligament; UEFA: Union of European Football Associations; LBP: Low Back Pain; CASP: Critical Appraisals Skills program; NAIRS: National Athletic Injury Registration System; BMI: Body Mass Index; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement

Introduction

Participation of women in various sports showed an evident increase in the recent decade. Their participation covered all levels of practice from elite to recreational levels [1]. The definition of 'elite' is variable but has been described as 'the best performers in their country in a certain sport who are competing at national or international levels' [2]. Soccer is an internationally popular sport [3] that has seen an exponential 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 1.270 million in 2016 to 1.365 million in 2017, with the number of women playing at the professional or semiprofessional level more than doubling in four years from 1,680 (2013) to 3,572 (2017) [4]. Despite increased women's participation in elite soccer, studies investigating injury in this cohort are sparse [5]. Soccer is a complex, high intensity and, contact sport, associated with a considerable risk of injury [3]. Epidemiological studies have shown an incidence of 10–35 injuries per 1000 game hours among players in men's professional soccer, compared to 9.1–24 injuries per 1000 game hours among professional women [6]. Although the overall incidence of injury was found to be higher in elite men soccer players than their women counterparts, the proportion of severe injuries (caused absence > 28 days lost) appears to be significantly higher in women [6].

A comparison of injuries among men and women 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 compared to men [7]. This high injury incidence has been found to impact negatively upon the related league, the clubs affected, and the players wellbeing too [3]. The risk factors for injury in soccer are complex and mediated by a host of intrinsic and

extrinsic considerations [8]. Several of these risk factors are shared between gender, including competitive trait anxiety and negative life event stress co related [9]. Exposing soccer players to large and rapid changes in athletic load has also been found to increase injury in elite soccer players of both sexes [10]. Furthermore, researchers have found that newly transferred players of both sexes were at a greater risk of non-contact injuries than existing players on the same team, and this risk was enhanced by player rotation in addition to monitoring, prevention, and recovery protocols by team staff [11]. Certain positions, including those of goalkeeper and midfielder, have also been associated with an increased prevalence of low back pain (LBP) in both sexes during a competitive season [12]. However, a number of factors that may preferentially expose women soccer players to injury have also been identified. Larruskain [7], and Niyonsenga [13] have suggested that differences between gender 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 anterior cruciate ligament (ACL) (five-fold) injuries in women soccer players compared to their men counterparts.

Furthermore, a study of elite Rwandan women 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 [13]. 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 generalizable to women. The increase in women's participation in elite soccer, with an evident increased incidence of severe injury, is an area worthy of exploration. To date, no review has synthesized the existing literature regarding possible intrinsic and extrinsic risk factors and for injury in this population. This systematic review aims to summarize risk factors, to inform future research into injury screening for these athletes. This systematical review objective is to explain elite female soccer injury epidemiology and showing its risk factors influence. For that reason, we analysed every scientific publications who treated about this topic.

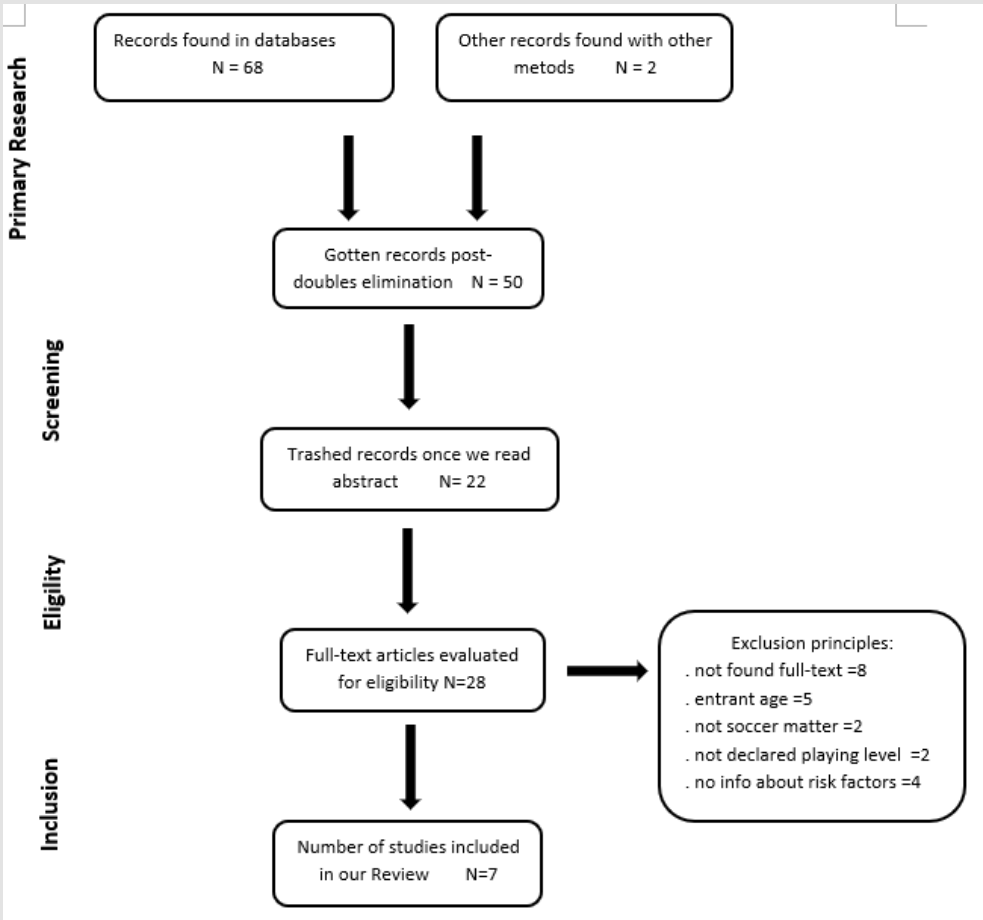

Diagram 1: Prisma.

Materials and Methods

We did systematical research according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement (PRISMA) as we summarized in Diagram 1. We kindly employed two databases (PubMed and Google) by using some key words combinations as "risk", "risk factors", "injury", "elite", "national", "professional", "female", "woman", "football", "soccer". We filtrated results according to their publication pattern: we ruled out single case-reports and we included only peer review articles publicated in English language. We decided to include only adult female players (≥ 18 years old) to minimize bias due to physical immaturity and growing damage. First application of these search criteria identified 70 studies. A considerable articles number was useless because "football" key word means rugby, American and Australian football too. They were not included. We also saved prospective reviews who treat about our topic. So, after a primary screening, we got 50 records. We excluded articles talked about unprofessional, young, male and university football players. On this way, once we read abstract, trashed records were 18 more. At the end full-text articles evaluated for elegibility were 28. Exclusion principles were: not found full-text, entrant age, not soccer matter, not declared playing level, no info about risk factors. The studies quality assessment was carried out using Critical Appraisals Skills program (CASP) [14]. A high-quality study was defined as scoring positively on > 50% of the 12 items in the CASP checklist [15].

Results

Just 7/70 studies were finally included in the review. We sum up their main features in the following table (Table 1). According to previous criteria, these seven articles demonstrated high quality and high value in CASP checklist (Table 2). Most articles of this review define injury as lost time out of playing and training. According to Blokland, et al. [1] an injury was defined as '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 [1]. Following the definition of injury used by the US National Athletic Injury Registration System (NAIRS), an injury was defined as a specific identifiable event in playing soccer that forced the player to miss the rest of at least 1 practice or game or sit out at least 1 practice or game [16]. Injuries were recorded, according to Larruskain, et al. [7], when a player was unable to participate in a future training session or match due to a physical complaint resulting from football training or match play and was considered injured until the medical staff cleared the player for full participation in training and match play (illnesses were excluded) [7]. Injuries in Ginza et al. study (2005) were defined as those conditions which were reported to and evaluated by the team physician or athletic trainer [6]. For the purpose of Owoeye, et al. [17] article, injury was defined as any physical complaint during a match, which necessitated medical attention from the physiotherapist, regardless of consequences with respect to absence from the remaining matches [17]. According to Nilstad, et al. [12] an injury was recorded if the player was unable to fully participate in soccer training or match play for at least 1 day beyond the day of injury; while, on the opposite side, according to Steffen, et al. [18] injury is a body lesion happens during a match or a training [18]. Analysing every injury definition, we can say that injury is lost time during which a player cannot play football, except for Steffen, et al. [18] who define injury not as lost time but as an event happening during a match or training. Studies summarized risk factors for female elite football players injury in two groups: intrinsic and extrinsic risk factors.

Table 1.

Athors, Year, Country	Entrant Female Number	Medium Age (years-old)	Injury Definition	Analysed Topics	Athlets Luague	Results
Blockland et al. 2017, Netherlands	114	22.4±3.3	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.	Flexibility status was assessed using the Beighton score at the beginning of the season and during the entire season (August 2014-June 2015) all injuries were recorded.	Top women league in Netherlands and Belgium	This study indicates that generalized joint hypermobility is not a risk factor for injuries in elite female soccer players (p=0,662).
Hartmut et al. 2010, Germany	254	22.8	A specific identifiable event in playing soccer that forced the player to miss the rest of at least 1 practice or game or sit out at least 1 practice or game.	Were collected data of all incidents happened during one complete outdoor season of the German women's soccer premier league	German Premier League(Bundesliga)	The seasonal peak was at the beginning of the competitive season. Injury rates doubled after the 60th minute. Female players suffer a high amount of head injuries and severe knee and ankle injuries. Torn ligaments in the ankle and knee are the most common injuries that require a long recovery period. Most of the severe injuries (.30 days) are due to noncontact intrinsic mechanism.

Larruskain et al. 2017, Spain	35(Male=50)	25±5	When a player was unable to participate in a future training session or match due to a physical complaint resulting from football training or match play and was considered injured until the medical staff cleared the player for full participation in training and match.	Injury epidemiology during 2010-2015 seasons was carefully reviewed.	Spanish First Division	Despite a 35% higher total injury incidence in men, it was reported an higher incidence of severe injuries and longer absences in women. In particular quadriceps strain was the most common injury in female team.
Giza et al. 2014, USA	202	Not Reported	Those conditions which were reported to and evaluated by the team physician or athletic trainer.	Injury epidemiology during the 2001 and 2002 seasons was carefully reviewed.	Women's United Soccer Association (WUSA)	Incidence of injury during game play is much higher than during practice. Injures about the knee are most common and predominating in high-level athletes.
Owoeye et al. 2017, Nigeria	300 (Male=356)	18-32	Any physical complaint during a match, which necessitated medical attention from the physiotherapist, regardless of consequences with respect to absence from the remaining matches.	Incidence and pattern of injuries in semi-professional male and female football players	18th National Sports Festival Football Tournament	The overall incidence of injuries among Nigerian semi-professional football players is high. Most of the injuries did not result in time-loss for both genders. Time-loss injuries were mostly minimal in male players but severe in female players.
Nilstad et al. 2014, Norway	173	21.5±4.1	When the player was unable to fully participate in soccer training or match play for at least 1 day beyond the day of injury.	Injury screening in a season and their association with BMI; a lower knee valgus angle; previous injuries	Norwegian elite female soccer league	A greater BMI was associated with thigh injuries (p=0,001); players with lower peak knee valgus angles in a dropjump landing were more likely to sustain a new ankle injury (p=0,04); a previous knee injury was associated with new injuries to the lower leg/foot (p=0,02)
Steffen et al. 2017, Norway	Soccer=429	21.1±4	Any injury occurring during regular team training or competition.	Balance platform; 3D motion system	Premier League	None of the postural control measures examined were associated with an increased ACL injury risk (p>0,05)

Table 2.

Question	**Blokland** et al. (2017)	**Hartmut et al. (2010)**	**Larruskain et al. (2017)**	**Giza et al. (2004)**	**Owoeye et al. (2017)**	**Nilstad et al.(2014)**	**Steffen et al.(2017)**
Did the study address a clearly focused issue?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the cohort recruited in an acceptable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the exposure accurately measured to minimize bias?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the outcome accurately measured to minimize bias?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Did the authors identified all important confounding factors?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Did they take into account the confounding factors in the design and/or analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Was the follow-up with subjects complete enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the follow-up with subjects long enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Has this study consistent results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are the results accurate enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are the results evidence-medicine based?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Can the results be applied to the local population?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do the results of this study fit with other available evidence?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are there applications of this study for practice?	yes	Yes	Yes	Yes	Yes	Yes	Yes
Overall quality	High	High	High	High	High	High	High

Intrinsic Risk Factors

According to Hartmut et al., Nilstad et al., and Ginza et al., a previous injury increases a second injury risk in the same segment. Another factor, according to Hartmut et al., Nilstad et al., Ginza et al. and Larruskain et al., which takes part in injury event, is the higher joint laxity during pre-ovulatory period and contraceptive drug use. Other injury reasons seem to be a high body mass index (BMI) and a low athletic preparation level. A common outcome (Hartmut et al., Ginza et al. and Oweye at al.) in higher injury risk is about increasing age. Finally, every article agrees on increasing injury risk in poor technical level.

Extrinsic Risk Factors

According to Hartmut et al., Larruskain et al. and Ginza et al., exposure time (number and frequency of practices and games) is one of the most important factors in calculating injury incidence. We found opposite results about player position: according to Hartmut et al. it didn't show a significant difference in injury incidence or patterns other than the fact that goalkeepers sustained more than 30% of all fractures concerning the upper extremities; on the other side, Ginza et al., demonstrated player position at the injury time influenced injury risk because of midfielders sustained the most injuries (34.1%), followed by defenders (28.1%), strikers (22.8%), and goalkeepers (15.0%). For Hartmut et al. and Owoeye et al. Most injuries happen during the second part of the match. Every study agrees severe injury probability is higher during a match than a practice.

Discussion

This systematic review objective is to list risk factors in female elite football player injuries. Results show us a lot of intrinsic and extrinsic factors could influence their body fitness.

Previous Injury

There is an association between a muscular-skeletal damage history and new-injury risk. A previous injury makes the segment more susceptible for a second lesion, especially same anatomical area concerned. Interestingly, univariate analyses revealed a 9-fold increased risk for a knee injury in players with a previous ACL injury in the same knee [19]. An higher second-injury incidence is connected to a wrong first lesion rehabilitation. A good rehabilitation is primary for overcoming strength, proprioception and kinematic segment mutations [16]. A retrospective study confirmed in 76% ankle injuries and in 10% tibial injuries there was a prior same segment lesion. Therefore, it may be necessary to define proper rehabilitation program and come-back-training protocol for injury prevention as is already recommended for other training contents [11]. Some authors have shown that pre-season neuromuscular training and fitness can reduce overall injury rates and it could represent a ''pre-selection'' of players who are at risk for an injury [6,17], although these results accentuate the importance of a more comprehensive analysis of the injury patterns and they should be carefully used.

Exposure

Player exposure time (as working for time unit) was one of the most important factors in calculating injury incidence, especially during a match [20]. Most studies confirm that matches have a higher incidence rate of injuries, especially during the second half of matches, because players are wearying and lower concentrated. So we strongly recommend a careful individual fitness program and to supervise the single work rate, that may be different in each player [21]. A proper workload optimises player performance and reduces unwanted training effects.

Player Position

Another important factor associated with an higher injury risk is the player position on the field. Analysing Giza et al. article, it's clear injures per 1000 game hours is highest in midfielders (34.1%) followed by defenders (28.1%), strikers (22.8%), and goalkeepers (15.0%) [22]. Owoeye et al. suggest that the midfielders at every match are exposed to injuries more than any player position, because their roles require utmost concentration, close marking, agility and speed which increase the injury risk [23]. Instead Hartmut at al. have another point of view: playing position did not show a significant difference in injury incidence or patterns other than the fact that goalkeepers sustained more than 30% of all fractures concerning the upper extremities and most cranial trauma. Therefore, we need more specific trails to confirm association between player position and injury risk.

Age

According to Nilstad, et al. 25 years older players are more injury susceptible than younger mates [24]. Age changements in older athletes, as putting on weight, losing flexibility and reduced calcium absorption, are regarded as risk factors [6,16]. We need more specific trails to verify association between age and injury severity.

Postural Control

Steffen, et al. [18], using measures on a balance platform and a 3D motion analysis system, found no association between postural control an increased ACL injury risk, even if highlight the role of varying neuromuscular training and balance components to be of importance for effective ACL injury risk reduction [25]. A variety of different reasons contributes to the high rate of ACL injuries in female soccer players, including differences in the techniques for faking movements like change of direction, cutting maneuvers, and deceleration which moves the body's centre of gravity further back [26-29]. Also women suffer head injuries up to 2.4 times more often than men, because in a heading duel, the player frequently gets into contact with the opponent's upper extremities and head. It seems reasonable to improve trunk muscles to maintain proper body tension in jumping for a heading duel and to train players to do penalty-free, athletic, and optimally timed headers [16]. We need more specific trails with valider measuring instruments to verify these conclusions [30-33].

Extra Risk Factors

Nilstand et al. noted an increased number of injuries in players with a higher BMI [34]. Hartmut et al. supposed an association between high rate of ACL injury and increased laxity dependent on gender and menstruation cycle [35]. This review showed an increased number of dominant arm injury in female soccer players, too [36]. In conclusion, articles concerning our research got poor evidence in testing an association between functional and anatomic risk factors and female elite soccer player injuries [37].

Limitations

This systematic review main limit could be low number of allowable studies [38]. Low number trials for single risk factor too. In addition, CASP analysis instrument doesn't use a detailed testing method score, so sometimes it may overestimate trial conclusions [39].

Conclusion

Risk injury factors in elite soccer female players are multifactorial, complex, and crossed each other's. This systematic review summarized the main risk factors to improve screening and to enable the creation of prevention protocols. How ever there is not enough investigation on this topic: we need more studies concerning higher quality conclusions. There are some intrinsic factors in women, like hormonal floating during menstruation cycle, which may influence the injury risk, so more inspection is necessary. In future, we need prospective trials, using strong and well-defined outcome measurements, with specific and female elite soccer players-dedicated guideline and management strategy.

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