Injury incidence rates in women's football: a systematic review and meta-analysis of prospective injury surveillance studies

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ABSTRACT

Objective To review the literature to establish overall, match and training injury incidence rates (IIRs) in senior (≥18 years of age) women's football (amateur club, elite club and international).

Design Systematic review and meta-analysis of overall, match and training IIRs in senior women's football, stratified by injury location, type and severity.

Data sources MEDLINE via PubMed; EMBASE via Ovid; CINAHL via EBSCO and Web of Science were searched from earliest record to July 2021.

Eligibility criteria for selecting studies (1) football players participating in a senior women's football league (amateur club or elite club) or a senior women's international football tournament; (2) the study had to report IIRs or provide sufficient data from which this outcome metric could be calculated through standardised equations; (3) a full-text article published in a peer-reviewed journal before July 2021; (4) a prospective injury surveillance study and (5) case reports on single teams were ineligible.

Results 17 articles met the inclusion criteria; amateur club (n=2), elite club (n=10), international (n=5). Overall, match and training 'time-loss' IIRs are similar between senior women's elite club football and international football. 'Time-loss' training IIRs in senior women's elite club football and international football are approximately 6–7 times lower than their equivalent match IIRs. Overall 'time-loss' IIRs stratified by injury type in women's elite club football were 2.70/1000 hours (95% CI 1.12 to 6.50) for muscle and tendon, 2.62/1000 hours (95% CI 1.26 to 5.46) for joint and ligaments, and 0.76/1000 hours (95% CI 0.55 to 1.03) for contusions. Due to the differences in injury definitions, it was not possible to aggregate IIRs for amateur club football.

Conclusion Lower limb injuries incurred during matches are a substantial problem in senior women's football. The prevention of lower limb joint, ligament, muscle and tendon injuries should be a central focus of injury prevention interventions in senior women's amateur club, elite club and international football.

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INTRODUCTION

Football (soccer) is the world's most popular sport with over 260 million participants globally, of which 30 million are female.[1] The Fédération Internationale de Football Association (FIFA) has the ambition of increasing the participation by girls and women in the sport to 60 million by 2026.[1] A report compiled by the Union of European Football Associations (UEFA) in 2017/2018 documented that the number of registered female players in UEFA member associations increased by 7.5% in 1 year from 1.27 million in 2016 to 1.37 million in 2017.[2] The report also highlighted that the number of registered professional and semiprofessional female players in UEFA's member associations more than doubled in 4 years from 1680 in 2013 to 3572 in 2017. The number of senior women's national teams among UEFA member associations rose from 47 in 2013 to 52 in 2017, with a concurrent increase in the number of senior domestic women's national leagues in UEFA member associations from 48 to 51.[2]

Women's football is a physically demanding contact sport involving intermittent bouts of sprinting, jogging, walking, jumping and changes of direction.[3–8] The physical demands of the game vary as a function of the level of play (ie, youth, amateur club, elite club, international), yet injury incidence rates (IIRs) across all levels of the women's game are high.[9–28] In a systematic review and meta-analysis of injuries in women's football, López-Valenciano *et al*[29] reported overall, match and training IIRs of 6.1/1000 hours (95% CI 4.6 to 7.7), 19.2/1000 hours (95% CI 16.0 to 22.4) and 3.5/1000 hours (95% CI 2.4 to 4.6), respectively. They also reported IIRs for the lower extremity, trunk, head and neck, and upper extremity of 4.8/1000 hours, 0.4/1000 hours, 0.3/1000 hours and 0.15/1000 hours, respectively. Regarding lower extremity injuries, they reported IIRs for the ankle, knee, thigh, lower leg/Achilles tendon, foot/toe and hip/groin of 1.1/1000 hours, 1.1/1000 hours, 0.9/1000 hours, 0.5/1000 hours, 0.4/1000 hours and 0.35/1000 hours, respectively. However, the systematic review and meta-analysis of López-Valenciano *et al*[29] has recently been criticised in a published commentary.[30] The main points of the criticism include: (1) a sole emphasis on 'time-loss' injuries; (2) lack of discussion regarding differences in injury reporting mechanisms and (3) drawing inferences from single-point estimates.

Injuries can have a substantial negative effect on team performance and can have a detrimental effect on the future career of football players.[31–33] FIFA's 2018 Women's Football Strategy outlines its plans to create women's football-specific medical and health programmes focused on injury prevention, playing conditions and female biology.[1] A thorough understanding of injury epidemiological outcome metrics in senior women's football, defined by FIFA

as age 18 and above, is a requisite initial step to inform the development and implementation of injury prevention initiatives.[34 35] Numerous prospective injury surveillance studies across different levels of play in senior women's football using different methodologies have been published in the past 30 years.[12–19 21 23 24 26 27] The objective of our systematic review and meta-analysis was to review the literature with the primary purpose of establishing overall, match and training IIRs in senior women's football (amateur club, elite club and international).

METHODS

We designed our review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) guideline.[36] Our PRISMA-P document is available as online supplemental file 1. Our review was registered in the PROSPERO International Prospective Register of Systematic Reviews (ID#CRD42020162895) before study selection and data extraction.

Eligibility criteria

To be deemed eligible for inclusion, studies were required to fulfil the following criteria (framed according to PICO): Population (P)—the study had to include: football players participating in a senior women's football league (amateur club or elite club) or senior women's international football tournament. Elite club football was defined as the highest national football league (eg, Frauen-Bundesliga in Germany).[12] Amateur club football was defined as any league below the highest national football league (eg, 2 Frauen-Bundesliga in Germany). International football was defined as a match between two national teams (online supplemental file 2). Intervention (I)—in this case the intervention is actually an exposure. The exposure is considered as either of the following: (1) participation in a senior women's football league (amateur club or elite club) for a minimum duration of one season; (2) participation in a senior women's international football tournament (eg, FIFA Women's World Cup). Comparator (C)—not applicable. Outcome (O)—the outcome of interest was injury (ie, a player sustained an injury defined as either time-loss, medical attention or all physical complaints). We used IIR as the primary outcome metric to quantify 'injury'. The study had to report IIRs or provide sufficient data from which this outcome metric could be calculated through standardised equations. IIR was calculated per 1000 units of exposure to football training or match play (ie, per 1000 hours). Additional criteria were as follows: (1) the study had to be a full-text article published in a peer-reviewed journal before July 2021; (2) the study had to be a prospective injury surveillance study and (3) case reports on single teams were ineligible.

Search strategy and study selection

A systematic search strategy was undertaken across electronic bibliographic databases; MEDLINE via PubMed; EMBASE via Ovid; CINAHL via EBSCO and Web of Science. The search terms were mapped to Medical Subject Headings (MeSH) terms where possible. Initially, search terms were applied from conception of each database to August 2019. The same systematic search strategy undertaken in July 2021 did not lead to the inclusion of any new studies.

The following is an example of the search conducted on the PubMed database: ("women"[MeSH Terms] OR "women"[All Fields]) AND ("football"[MeSH Terms] OR "football"[All Fields]) OR ("soccer"[MeSH Terms] OR "soccer"[All Fields]) AND ("wounds and injuries"[MeSH Terms] OR ("wounds"[All Fields] OR "injuries"[All Fields])

Studies were imported from EndNote into the systematic review software, 'Rayyan' (Cambridge, Massachusetts, USA). We used Rayyan to identify, screen (title, abstract and full-text articles), and include eligible records. Duplicate records were identified and removed. We exported included studies to an Endnote folder for data extraction. Study selection was performed by two reviewers (DH and ED) independently. A third reviewer (MH) was available if required to resolve disagreements among these reviewers and to facilitate consensus. The two reviewers independently screened the titles and abstracts of the identified peer-reviewed articles to assess eligibility for inclusion in this review. Full-length texts of remaining peer-reviewed articles were sought and reviewed in full to determine eligibility when reviewers were uncertain about their eligibility from title and abstract screening. The reference lists of included articles were searched to identify other potentially relevant articles. In addition, citation tracking was also used to identify potentially eligible studies.

Outcome metrics

The primary outcome measure of interest was injury (ie, a player has sustained an injury defined as 'time-loss', 'medical attention' or 'all physical complaints'). We used IIR, quantified per 1000 units of exposure (ie, per 1000 hours), as the primary outcome metric to quantify 'injury' within each study. Where possible we included the following outcome metrics: (1) overall IIR, (2) match IIR and (3) training IIR. If possible these outcome metrics were also calculated for: (1) level of play, (2) location of injury, (3) type of injury and (4) severity of injury (online supplemental file 2).

Data extraction

A standardised data extraction sheet (created in Microsoft Excel) was used to extract data. Data extraction was performed by two reviewers (DH and ED) independently. A third reviewer (MH) was consulted to resolve disagreements among these reviewers and to facilitate consensus. The data extraction sheet included the following items: (1) study characteristics, (2) participant characteristics, (3) study outcomes and (4) IIR data.

Risk of bias assessment and study quality

Presently, we are unaware of any tools available to correctly assess risk of bias in prospective injury surveillance studies. In a recent two-part educational review, Büttner *et al* cautioned that study quality and risk of bias are not synonymous.[37 38] They also recommended against the modification of risk of bias tools by adding new items or omitting existing items for the purpose of suiting the study characteristics.[37 38] Hence, we did not perform any risk of bias assessment for the studies included. To evaluate the quality of the data collection procedures of the included studies, we mapped all studies to the methodological domains of the 'checklist of issues that should be included in reports of studies of football injuries'.[39] This was performed by DH and ED. The results of this mapping process are presented in online supplemental file 3.

Statistical analysis

We performed a meta-analysis when relevant data had sufficient conceptual and methodological homogeneity between studies to permit quantitative aggregation. This decision was made by the authors based on their interpretation of perceived differences between study subpopulations (eg, amateur club, elite club,

international), exposure type and outcome metrics reported, as recommended by Higgins and Green,[40] Borenstein *et al*,[41] and Borenstein *et al*.[42]

IIRs and 95% CI limits were extracted from each study. When IIRs were not directly reported, we calculated/computed incidence rates, if sufficient data were presented in each study. We required sufficient data, so that we could divide the total number of injuries reported in the relevant study by the total number of exposure units (ie, exposure hours), which was then expressed per 1000 exposure hours. Fixed-effects and random-effects Poisson regression meta-analysis models were performed (depending on the clinical and methodological heterogeneity between included studies) to estimate pooled IIRs, as conducted in previous meta-analyses that have aggregated the results of injury surveillance studies.[43–45] Poisson-normal models were fitted using the log incidence rate—the response variable was the total number of recorded injuries divided by the log of the number of exposure hours. The estimated pooled log incidence rate was then exponentiated (ie, back-transformed) to reflect the pooled IIR and corresponding 95% intervals, per 1000 hours of exposure. In addition to modelling the pooled incidence rates for injuries that occur in match play and training, IIRs were also stratified for different levels of play, location of injury, type of injury and severity of injury.

In a random-effects model, it is assumed that the observed estimates (IRR in this case) can vary across studies, because of true differences in IRR, as well as sampling variability. τ^2 is the variance in distribution of true outcomes. τ^2 is on the same scale as the outcome metric (ie, IIR) and reflects the absolute amount of true heterogeneity.[41 42] I^2 statistics were also calculated to estimate the proportion of total variation that is attributable to true variation/heterogeneity.[46] Tentative benchmarks have been proposed to interpret I^2 statistics whereby I^2 values of 25%, 50% and 75% are considered low, moderate and high heterogeneity, respectively.[47] I^2 values greater than 75% were taken to indicate considerable heterogeneity between the studies, as were statistically significant Wald χ^2 tests ($p<0.05$). Meta-analytical models were constructed in RStudio (The R Foundation for Statistical Computing, Vienna, Austria) using the 'metafor' package.[47]

RESULTS

Descriptive characteristics of the studies

A total of 10 767 titles were identified through database searching and an additional 7 were identified through hand searching reference lists. From this total, 3349 references (31.10%) were excluded as duplicates, 7365 (68.40%) were removed after reading the title and/or abstract, 23 (0.21%) were excluded due to being a wrong study design and 19 (0.18%) were eliminated due to wrong study population. One study could not be accessed. The search process led to 17 articles meeting the inclusion criteria.[12 14–19 23 26 27 48–54] The PRISMA flow chart for the inclusion of studies is outlined in online supplemental file 4. Included studies were categorised as follows: (1) amateur club (n=2), (2) elite club (n=10) and (3) international (n=5). Metrics extracted included overall, match and training IIRs. Where possible IIRs were also extracted for location of injury, type of injury and severity of injury. Outcome metrics extracted and suitable for meta-analysis are detailed in online supplemental file 5.

Amateur club football

Two women's amateur club football injury surveillance studies were included.[50 54] These studies used 'time-loss' and 'hybrid'—did not satisfy that of a 'time-loss' or an 'all physical complaints' injury definition—injury definitions, respectively; hence, meta-analyses of reported or calculable outcome metrics were not possible, and as such, individual study results are reported below.

Amateur club football: IIRs

Jacobson and Tegner[50] reported overall, match and training 'time-loss' IIRs of 9.6/1000 hours, 13.3/1000 hours and 8.4/1000 hours, respectively—95% CIs were not reported or calculable from the data reported in the article. McNoe and Chalmers[54] reported match and training IIRs of 80.1/1000 hours (95% CI 65.0 to 98.1) and 11.9/1000 hours (95% CI 6.8 to 20.7), respectively. From these data, it was possible to calculate an overall IIR, which equated to 47.84/1000 hours (95% CI 38.56 to 57.13).

Amateur club football: location of injury

Jacobson and Tegner[50] reported on overall, match and training 'time-loss' IIRs stratified by location of injury. The ankle, knee, thigh, spine and head had the highest match IIRs; 3.9/1000 hours, 3.5/1000 hours, 1.9/1000 hours, 0.9/1000 hours and 0.9/1000 hour, respectively—95% CIs were not reported or calculable from the data reported in the article. McNoe and Chalmers[54] did not report on IIRs stratified by location of injury among the senior (≥18 years) female players included in their study.

Amateur club football: type of injury

Jacobson and Tegner[50] reported on overall 'time-loss' IIRs stratified by type of injury, but these were not substratified by match and training exposures. The three most common types of injury were: sprains (3.6/1000 hours); contusions (1.3/1000 hours); and strains (0.7/1000 hours). McNoe and Chalmers[54] did not report overall, match or training IIRs stratified by type of injury among the senior (≥18 years) female players included in their study.

Amateur club football: severity of injury

Neither Jacobson and Tegner[50] nor McNoe and Chalmers[54] reported on IIRs stratified by severity of injury.

Elite club football

Ten women's elite club football injury surveillance studies were included.[12 14–18 23 26 48 49] The study by Nilstad *et al*[23] included separate injury incidence outcome metrics based on player self-report and the recordings of medical personnel; we included both sets of data. Since Ekstrand *et al*[12] reported separate injury incidence outcome metrics for matches played on grass and artificial turf, we included both sets of data. It was not possible to include data from Giza *et al*[15] in any meta-analyses. Therefore, in total, 11 data sets were available for potential aggregation. All studies used a 'time-loss' injury definition, with the study by Babwah[48] being the only study to present some 'all physical complaints' injury incidence outcome metrics.

Elite club football: IIRs

Data from 8, 7 and 7 'time-loss' injury definition data sets could be aggregated for overall, match and training IIRs, respectively. The overall, match and training IIRs were, 5.63/1000 hours (95% CI 4.03 to 7.86), 19.07/1000 hours (95% CI 13.73 to 26.47) and 3.27/1000 hours (95% CI 2.15 to 4.96), respectively (table 1).

Elite club football: location of injury

Data from up to six 'time-loss' injury definition data sets could be aggregated for overall IIR stratified by location of injury

Table 1 Women's elite football: overall, match and training IIR (per 1000 hours of exposure)

Description		Poisson regression meta-analysis						
Category	Injury definition	Model	K	Summary incidence rate	95% CI	χ^2_{Wald}	T^2	I^2
Overall	Time-loss	Random	8	5.63	4.03 to 7.86	177.28 (p<0.001)	0.225	97.61%
Match	Time-loss	Random	7	19.07	13.73 to 26.47	66.73 (p<0.001)	0.181	93.92%
Training	Time-loss	Random	7	3.27	2.15 to 4.96	121.08 (p<0.01)	0.30	96.25%

T^2, tau-squared estimate (ie, the variance of true IIRs) ; I^2, I^2 statistic (ie, the proportion of observed variation that is attributable to true, between-study variation).
IIRs, injury incidence rates .

(head and neck; trunk; upper limb; lower limb). The location of injury with the highest overall IIR was the lower limb (4.54/1000 hours; 95% CI 3.97 to 5.19) (table 2).

It was possible to aggregate match data for 'time-loss' injury stratified by location of injury. Data from up to three 'time-loss' injury definition data sets could be aggregated for match IIR stratified by location of injury. The lower limb was the location of injury with the highest match IIR (11.52/1000 hours; 95% CI 9.97 to 13.32) (table 2).

Data from up to three 'time-loss' injury definition data sets could be aggregated for training IIR stratified by location of injury. The location of injury with the highest training IIR was the lower limb (2.33/1000 hours; 95% CI 2.03 to 2.68) (table 2).

Elite club football: type of injury

Three 'time-loss' data sets could be aggregated for overall IIR, stratified by type of injury (fractures and bone stress; joint and ligaments; muscle and tendon; contusion; laceration and skin lesion; central nervous system (CNS)/peripheral nervous system (PNS); other injuries). Muscle and tendon injuries had the highest overall IRR (2.70/1000 hours; 95% CI 1.12 to 6.50) (table 3). Data from two 'time-loss' injury definition data sets could be aggregated for match IIR stratified by type of injury. The type of injury with the highest match IIR was joint and ligaments injury (5.31/1000 hours; 95% CI 3.89 to 7.23) (table 3). Data from two 'time-loss' injury definition data sets could be aggregated for training IIR stratified by type of injury. The type of injury with the highest training IIR was muscle and tendon injury (1.10/1000 hours; 95% CI 0.82 to 1.48) (table 3).

Elite club football: severity of injury

Data from up to 4 'time-loss' injury definition data sets could be aggregated for overall IIR stratified by severity of injury (slight; minimal; mild; moderate; severe). Moderate injuries had the highest overall IIR (1.64/1000 hours; 95% CI 1.40 to 1.92) (online supplemental file 6). Data from two 'time-loss' injury definition data sets could be aggregated for match IIR stratified by severity of injury. Minimal injuries had the highest match IIR (4.51/1000 hours; 95% CI 3.22 to 6.31) (online supplemental file 6). Data from two 'time-loss' injury definition data sets could be aggregated for training IIR stratified by severity of injury. Mild and moderate injuries had the highest training IIRs (both 0.88/1000 hours; 95% CI 0.64 to 1.22) (online supplemental file 6).

International football

Data from five international women's football injury surveillance studies were included.[19 27 51–53] Junge *et al*[52] reported on some 'all physical complaints' injury incidence outcome metrics from the 1999 Women's World Cup and 2000 Olympic Games. Junge *et al*[53] reported on some 'all physical complaints' injury incidence outcome metrics from the 2004 Olympic Games. Junge and Dvorak[19] reported on some 'all physical complaint' injury incidence outcome metrics from the 2003 Women's World Cup, the 2002 and 2004 FIFA U-19 Women's World Championships, as well as the 2006 FIFA U-20 Women's World Championships. Hägglund *et al*[51] reported on some 'time-loss' injury incidence outcome metrics from the 2006, 2007 and 2008 UEFA U-19 Women's European Championships. Waldén *et al*[27] reported on some 'time-loss' injury incidence outcome metrics for the

Table 2 Women's elite football: overall, match and training IIRs (per 1000 hours of exposure) stratified by location of injury

Description			Poisson regression meta-analysis						
Category	Injury definition	Anatomical location	Model	K	Summary incidence rate	95% CI	χ^2_{Wald}	T^2	I^2
Overall	Time-loss	Head and neck	Random	5	0.35	0.26 to 0.48	6.65 (p=0.16)	0.031	26.46%
Overall	Time-loss	Upper limb	Random	6	0.18	0.11 to 0.30	12.62 (p=0.027)	0.193	55.69%
Overall	Time-loss	Trunk	Random	5	0.35	0.22 to 0.55	9.40 (p=0.052)	0.141	61.74%
Overall	Time-loss	Lower limb	Random	6	4.54	3.97 to 5.19	27.30 (p<0.001)	0.021	77.19%
Match	Time-loss	Head and neck	Fixed	2	1.06	0.53 to 2.12	0.31 (p=0.58)	NA	NA
Match	Time-loss	Upper limb	Fixed	3	0.25	0.09 to 0.67	0.09 (p=0.96)	NA	NA
Match	Time-loss	Trunk	Fixed	2	0.66	0.28 to 1.59	0.01 (p=0.99)	NA	NA
Match	Time-loss	Lower limb	Fixed	3	11.52	9.97 to 13.32	0.49 (p=0.78)	NA	NA
Training	Time-loss	Head and neck	Fixed	2	0.17	0.08 to 0.36	0.69 (p=0.41)	NA	NA
Training	Time-loss	Upper limb	Fixed	3	0.11	0.05 to 0.20	3.69 (p=0.16)	NA	NA
Training	Time-loss	Trunk	Fixed	2	0.05	0.01 to 0.20	0.01 (p=0.99)	NA	NA
Training	Time-loss	Lower limb	Fixed	3	2.33	2.03 to 2.68	1.44 (p=0.49)	NA	NA

T^2, tau-squared estimate (ie, the variance of true IIRs); I^2, I^2 statistic (ie, the proportion of observed variation that is attributable to true, between-study variation).
IIRs, injury incidence rates; NA, not available.

Table 3 Women's elite football: overall, match and training IIRs (per 1000 hours of exposure) stratified by type of injury

Description			Poisson regression meta-analysis						
Category	Injury definition	Injury type	Model	K	Summary incidence rate	95% CI	χ^2_{Wald}	T^2	I^2
Overall	Time-loss	Fractures and bone stress	Random	3	0.43	0.10 to 1.82	28.39 (p<0.001)	1.38	87.45%
Overall	Time-loss	Joint and ligaments	Random	3	2.62	1.26 to 5.46	32.65 (p<0.01)	0.38	91.31%
Overall	Time-loss	Muscle and tendon	Random	3	2.70	1.12 to 6.50	57.45 (p<0.001)	0.568	94.35%
Overall	Time-loss	Contusion	Random	3	0.76	0.55 to 1.03	2.51 (p=0.29)	0.10	23.43%
Overall	Time-loss	Laceration and skin lesion	Random	3	0.07	0.003 to 1.33	11.95 (p<0.01)	4.62	84.51%
Overall	Time-loss	CNS/PNS	Random	3	0.23	0.13 to 0.41	1.68 (p=0.43)	0.05	21.62%
Overall	Time-loss	Other injuries	Random	3	0.17	0.09 to 0.34	1.62 (p=0.44)	0.08	26.79%
Match	Time-loss	Fractures and bone stress	Fixed	2	0.13	0.02 to 0.94	0.01 (p=0.99)	NA	NA
Match	Time-loss	Joint and ligaments	Fixed	2	5.31	3.89 to 7.23	0.13 (p=0.72)	NA	NA
Match	Time-loss	Muscle and tendon	Fixed	2	3.32	2.24 to 4.91	0.19 (p=0.66)	NA	NA
Match	Time-loss	Contusion	Fixed	2	3.45	2.35 to 5.06	0.04 (p=0.85)	NA	NA
Match	Time-loss	Laceration and skin lesion	Fixed	2	0.13	0.02 to 0.94	0.01 (p=0.99)	NA	NA
Match	Time-loss	CNS/PNS	Fixed	2	0.93	0.44 to 1.95	0.02 (p=0.89)	NA	NA
Match	Time-loss	Other injuries	Fixed	2	0.53	0.19 to 1.40	0.01 (p=0.99)	NA	NA
Training	Time-loss	Fractures and bone stress	Fixed	2	0.20	0.10 to 0.39	0.10 (p=0.75)	NA	NA
Training	Time-loss	Joint and ligaments	Fixed	2	1.08	0.80 to 1.45	4.53 (p=0.03)	NA	NA
Training	Time-loss	Muscle and tendon	Fixed	2	1.10	0.82 to 1.48	1.92 (p=0.17)	NA	NA
Training	Time-loss	Contusion	Fixed	2	0.32	0.19 to 0.55	0.02 (p=0.90)	NA	NA
Training	Time-loss	Laceration and skin lesion	Fixed	2	NA*	NA*	NA	NA	NA
Training	Time-loss	CNS/PNS	Fixed	2	0.10	0.04 to 0.26	0.20 (p=0.66)	NA	NA
Training	Time-loss	Other injuries	Fixed	2	0.10	0.04 to 0.26	5.50 (p=0.02)	NA	NA

T^2, tau-squared estimate (ie, the variance of true IIRs) ; I^2, I^2 statistic (ie, the proportion of observed variation that is attributable to true, between-study variation).
*Zero events reported in studies included in this meta-analysis, thus yielding no summary effect estimate.
CNS, central nervous system; IIRs, injury incidence rates; NA, not available; PNS, peripheral nervous system.

2005 UEFA Women's European Championships. Seven data sets were available for potential aggregation using an 'all physical complaints' injury definition, with four data sets being available for potential aggregation using a 'time-loss' injury definition.

International football: IIRs

Data from four 'time-loss' injury definition data sets could be aggregated for overall, match and training IIRs, respectively. The overall, match and training IIRs were, 9.28/1000 hours (95% CI 7.22 to 11.93), 22.78/1000 hours (95% CI 17.07 to 30.42) and 3.30/1000 hours (95% CI 1.99 to 5.47), respectively (table 4). Data from seven 'all physical complaints'injury definition data sets could be aggregated for match IIR; the match IIR was 67.39/1000 hours (95% CI 61.00 to 74.45) (table 4).

International football: location of injury

Data from two 'all physical complaints' injury definition data sets could be aggregated for match IIR stratified by location of injury (head and neck; trunk; upper limb; lower limb). The location of injury with the highest match IIR was the lower limb (42.16/1000 hours; 95% CI 31.77 to 55.95) (table 5).

International football: type of injury

Data from two 'all physical complaints' injury definition data sets could be aggregated for overall IIR stratified by type of injury (fractures and bone stress; joint and ligaments; muscle and tendon; contusion; laceration and skin lesion; CNS/PNS; other injuries). The type of injury with the highest overall IIR was joint and ligaments injury (16.69/1000 hours; 95% CI=10.65 to 26.16) (table 6).

International football: severity of injury

Data from four 'time-loss' injury definition data sets could be aggregated for overall IIR stratified by severity of injury (slight; minimal; mild; moderate; severe). Minimal injuries had the highest overall IIR (5.02/1000 hours; 95% CI 3.57 to 7.07) (online supplemental file 6). Data from two 'all physical complaints' injury definition data sets could be aggregated for match IIR stratified by severity of injury (slight, minimal, mild, moderate and; severe). Slight injuries had the highest match IIR (33.38/1000 hours; 95% CI 24.29 to 45.87) (online supplemental file 6).

Study quality

We mapped all included studies to the 'checklist of issues that should be included in reports of studies of football injuries'

Table 4 Women's international football: overall, match and training injury incidence rates (per 1000 hours of exposure)

Description		Poisson regression meta-analysis				
Category	Definition	Model	K	Summary incidence rate	95% CI	χ^2_{Wald}
Overall	Time-loss	Fixed	4	9.28	7.22 to 11.93	6.42 (p=0.093)
Match	Time-loss	Fixed	4	22.78	17.07 to 30.42	4.22 (p=0.24)
Match	All physical complaints	Fixed	7	67.39	61.00 to 74.45	23.85 (p<0.001)
Training	Time-loss	Fixed	4	3.30	1.99 to 5.47	7.30 (p=0.063)

Table 5 Women's international football: match injury incidence rates (per 1000 hours of exposure) stratified by location of injury

Description			Poisson regression meta-analysis				
Category	Injury definition	Anatomical location	Model	K	Summary incidence rate	95% CI	χ^2_{Wald}
Match	All physical complaints	Head and neck	Fixed	2	13.18	7.94 to 21.85	0.59 (p=0.44)
Match	All physical complaints	Upper limb	Fixed	2	5.27	2.37 to 11.73	0.10 (p=0.75)
Match	All physical complaints	Trunk	Fixed	2	1.76	0.44 to 7.02	0.03 (p=0.85)
Match	All physical complaints	Lower limb	Fixed	2	42.16	31.77 to 55.95	1.26 (p=0.26)

(amended from Fuller *et al*[39]) (table 7). All studies included in our review specified study design, duration of study, organisational setting, gender of players, level of play and geographical location. Twelve per cent of the included studies did not include a definition of injury, involve medical personnel, clarify the frequency of recording of injuries, and specify the number of match injuries. Twenty-four per cent of the studies did not specify the number of teams or number of players included and the frequency of recording of exposure data. Thirty-five per cent of the studies did not confirm whether training was provided to club/national team staff to improve the quality of data collection and did not specify the number of training injuries. Forty per cent did not include the age range of the players. Forty-one per cent and 59% of the studies did not include the number of match exposures and the number of training exposures, respectively.

DISCUSSION

We performed a systematic review and meta-analyses (where possible) to quantify IIRs in senior women's football (amateur club, elite club and international). Our analyses indicated that when using a 'time-loss' definition of injury, overall, match and training IIRs are similar between senior women's international football (overall, match and training IIRs were 9.28/1000 hours, 22.78/1000 hours and 3.30/1000 hours, respectively) and senior women's elite club football (overall, match and training IIRs were, 5.63/1000 hours, 19.07/1000 hours and 3.27/1000 hours, respectively). It was not possible to perform meta-analyses for the data extracted from the two included studies on senior women's amateur club football.

Injury incidence rates

Our meta-analyses showed that the overall, match and training 'time-loss' IIRs for women's elite club football were 5.63/1000 hours, 19.07/1000 hours and 3.27/1000 hours, respectively. López-Valenciano *et al*[45] reported that the overall, match and training 'time-loss' IIRs in men's elite club football (ie, professional national leagues) were 7.5/1000 hours, 32.3/1000 hours and 3.8/1000 hours, respectively. Thus it appears that training 'time-loss' IIRs in men's and women's elite club football are similar, but that match 'time-loss' IIRs in men's football are substantially higher.

A potential reason for the differences in match 'time-loss' IIRs between men's and women's elite club football could be attributed to the higher sprinting demands in men's football[55 56] (although direct comparisons are limited by the lack of consensus on speed thresholds in women's elite club football),[3] the high number of contact injuries in men's elite club football,[16 21 52] and the provision of better medical support in men's elite club football—leading to earlier and more accurate injury diagnoses.[21 57]

Our meta-analyses showed that the overall, match and training 'time-loss' IIRs for women's international football were 9.28/1000 hours, 22.78/1000 hours and 3.30/1000 hours, respectively. López-Valenciano *et al*[45] reported that the overall, match and training 'time-loss' IIRs in men's international tournaments were 9.8/1000 hours, 41.1/1000 hours and 3.5/1000 hours, respectively. The same pattern emerges in international football as in elite club football, with similar 'time-loss' training IIRs between men's and women's international football but a substantially higher 'time-loss' match IIR in men's compared with women's international football. The reasons for the differences in 'time-loss' match IIRs between men's and women's international football are likely to be similar to those already discussed for elite club football.

Our analyses indicate that when a 'time-loss' injury definition is used, women's elite club football and women's international football have similar match IIRs (19.07/1000 hours vs 22.78/1000 hours, respectively). This is surprising, as previous research has highlighted that international players reach higher velocities and complete longer distances at high speed and sprinting intensities than domestic elite club players.[4 9 58 59]

In contrast, 'time-loss' match IIRs for men's professional club (ie, elite) and men's international football are not completely comparable, with IIRs of 32.3/1000 hours and 41.1/1000 hours, respectively, being reported in published literature.[45] We speculate that this difference between men's and women's data could be explained by the fact that during a typical season, men's elite clubs play 50–60 matches,[60 61] with international players then competing in international tournaments involving a congested

Table 6 Women's international football: match injury incidence rates (per 1000 hours of exposure) stratified by type of injury

Description			Poisson regression meta-analysis				
Category	Injury definition	Injury type	Model	k	Summary incidence rate	95% CI	χ^2_{Wald}
Match	All physical complaints	Fractures and bone stress	Fixed	2	0.88	0.12 to 6.24	0.01 (p=0.99)
Match	All physical complaints	Joint and ligaments	Fixed	2	16.69	10.65 to 26.16	3.54 (p=0.06)
Match	All physical complaints	Muscle and tendon	Fixed	2	10.54	5.99 to 18.56	2.43 (p=0.12)
Match	All physical complaints	Contusion	Fixed	2	15.81	9.96 to 25.09	5.87 (p=0.02)
Match	All physical complaints	Laceration and skin lesion	Fixed	2	3.51	1.32 to 9.36	0.01 (p=0.99)
Match	All physical complaints	CNS/PNS	Fixed	2	3.51	1.32 to 9.36	0.07 (p=0.79)
Match	All physical complaints	Other injuries	Fixed	2	6.15	2.93 to 12.90	0.01 (p=0.99)

CNS, central nervous system; PNS, peripheral nervous system.

Table 7 Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller *et al*)[39]

	Studies																
	McNoe and Chalmers[54]	Jacobson and Tegner[50]	Ibikunle *et al*[49]	Babwah[48]	Nilstad *et al*[23]	Giza *et al*[15]	Ekstrand *et al*[12]	Gaulrapp *et al*[17]	Hägglund *et al*[51]	Tegnander *et al*[26]	Jacobson and Tegner[18]	Faude *et al*[14]	Hägglund *et al*[51]	Waldén *et al*[27]	Junge and Dvorak[19]	Junge *et al*[53]	Junge *et al*[52]
Study design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Duration of study	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Organisational setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Geographical location	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No of teams	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
No of players	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
Age range of players	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
Gender of players	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Level of play	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Medical personnel involved	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓
Frequency of recording injuries	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	✓
Frequency of recording exposure data	✓	✓	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
Training to improve the quality of data collection	✓	✓	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓	✓	✓	✓	✗
Definition of injury	✓	✓	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
Definition of exposure	✓	✓	✗	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✗	✓
No of match exposures	✗	✗	✓	✓	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✗	✓	✓
No of match injuries	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
No of training exposures	✗	✗	✓	✗	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✗	✗	✗
No of training injuries	✓	✓	✓	✗	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗

match fixture list at the end of the season. The accumulation of fatigue at the end of the season may heighten the risk of injury during men's international tournaments. In comparison, women's elite clubs play 20–40 games during the season,[12 14–18 23 26 48 49] and thus may be able to better tolerate the loads of international tournaments at the end of the season.

A majority of time in women's football is spent training but, similar to the results of the UEFA male elite club injury study,[62] our analyses show that 'time-loss' training IIRs in women's elite club football (3.27/1000 hours) and women's international football (3.30/1000 hours) are approximately 6–7 times lower than their equivalent match IIRs (elite club=19.07/1000 hours; international=22.78/1000 hours). It is possible that the composition of training sessions at elite club and international levels of the women's game do not prepare players sufficiently for the physical demands of match play.

Injury location

Our meta-analysis of women's elite club football studies showed overall highest to lowest 'time-loss' IIRs by location main grouping as follows: lower limbs, head and neck, trunk, and upper limbs. The pattern that López-Valenciano *et al*[45] reported in their meta-analysis of overall 'time-loss' IIRs stratified by location main grouping in men's elite club football were, from highest to lowest: lower limbs, trunk, upper limbs and head and neck. The biggest difference between men's and women's football IIRs stratified by location main grouping is that head and neck injuries are the least common in men's elite club football but they are the second most common in women's elite club football and women's international football.

Fuller *et al*[63] examined all head injuries from multiple FIFA competitions and reported that concussions accounted for 22% of head and neck injuries in female players but only 8% of head and neck injuries in male players, with associated IIRs of 2.6/1000 hours in women's football and 1.1/1000 hours in men's football. Fuller *et al*[63] speculated that risk factors for head and neck injuries in female players may include the greater head-neck segment peak angular acceleration and displacement in females than in males when heading the ball, as well as females' lower levels of isometric neck strength, neck girth and head mass—resulting in lower levels of head-neck segment stiffness. There is a need for high-quality longitudinal prospective studies to investigate risk factors for head and neck injuries in women's football. Of interest, many of the injury surveillance studies in women's football included in our review were conducted prior to the introduction of the rule change whereby a straight red card (ie, sent off) is now received by a player for deliberate elbow-to-head contact. There is evidence from men's elite football that this rule change led to a 29% reduction in head injuries in the first German Bundesliga.[64]

Injury type

Our meta-analysis of women's elite club football studies[12 49] showed overall 'time-loss' IIRs for injury type of 2.70/1000 hours for muscle and tendon, 2.62/1000 hours for joint and ligaments, 0.76/1000 hours for contusion, 0.43/1000 hours for fractures and bone stress, and 0.23/1000 hours for CNS/PNS injuries. In their meta-analysis of injuries in men's professional football, López-Valenciano *et al*[45] reported 'time-loss' IIRs for injury type of 4.6/1000 hours for muscle and tendon, 1.4/1000 hours for contusion, 0.6/1000 hours for other injuries, 0.4/1000 hours for joint and ligaments, and 0.2/1000 hours for fractures and bone stress. Muscle and tendon injuries are the most common overall injury type in women's elite club football with an IIR of 2.70/1000 hours, but we urge caution as this finding is based on aggregation of data from only two studies. However, it would appear that the combined findings of data stratified by injury location main grouping and injury type suggest that muscle and tendon injuries of the lower limb (and particularly the thigh) are a primary problem in women's elite club football. This may be due to the higher running demands in women's elite club football in comparison to lower levels of the game.[4 9 59 65]

Despite an 'all physical complaints' injury definition being used in women's international football[52 53] and a 'time-loss' injury definition being used in women's elite club football,[12] the same match IIR pattern emerges for injury types. In women's international football, our meta-analysis shows that the five injury types with the highest match IIRs are: joint and ligaments (16.69/1000 hours), contusions (15.81/1000 hours), muscle and tendons (10.54/1000 hour), other injuries (6.15/1000 hours) and CNS/PNS injuries (3.51/1000 hours). In women's elite club football, our meta-analysis shows that the five injury types with the highest match IIRs injury are: joint and ligaments (5.31/1000 hours), contusions (3.45/1000 hours), muscle and tendons (3.32/1000 hours), CNS/PNS injuries (0.93/1000 hours) and other injuries (0.53/1000 hours).

Injury severity

Comparisons between overall 'time-loss' injury severity IIRs in women's elite club football and women's international football were possible. The majority of injuries in international football were of minimal severity (IIR 5.26/1000 hours),[27 51] whereas the IIRs for minimal, mild and moderate injuries in elite club football were 1.21/1000 hours, 1.26/1000 hours and 1.64/1000 hours, respectively.[12 16 18] It is possible that the high IIR of minimal severity injuries in women's international football in comparison to women's elite club football could be due to a higher level of medical care at international level versus elite club level. The FIFA Benchmarking Report in women's football in 2021 highlighted the gaps in medical care at elite club level by showing that of the 30 elite-level women's football leagues and their respective clubs surveyed, 30% did not have access to a doctor and 26% did not have access to a physiotherapist.[66] Greater access to medical care at international level might mean that more minimal injuries are diagnosed and treated.[19]

Despite an 'all physical complaints' injury definition being used in international match data[52 53] and a 'time-loss' injury definition being used in elite club match data,[12] the same pattern of match injury severity emerges. In women's international football, our meta-analysis shows that match injury severity IIRs are slight (33.38/1000 hours), minimal (14.05/1000 hours), mild (6.15/1000 hours), moderate (6.15/1000 hours) and severe (0.88/1000 hours). In women's elite club football our meta-analysis shows that match injury severity IIRs are minimal (4.51/1000 hours), moderate (3.85/1000 hours), mild (3.45/1000 hours) and severe (2.12/1000 hours).

Injury definitions

In the consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries, Fuller *et al*[39] defined an 'all physical complaints' injury as any injury sustained by a player that results from a football match or football training, irrespective of the need for medical attention or time-loss from football activities. An injury that results in a player receiving medical attention is referred to as a 'medical attention' injury, and an injury that results in a player being unable

to take a full part in future football training or match play as a 'time-loss' injury. Online supplemental file 7 outlines the injury definitions used in all the studies included in our review. Best practice, as per the consensus statement,[39] includes the simultaneous reporting of injury outcome metrics for 'all physical complaints', 'medical attention' and 'time-loss' injuries. The two amateur club studies included in our review used a 'time-loss' and a 'hybrid' (ie, does not satisfy the criteria for classification as 'all physical complaints' or 'time-loss') injury definition, respectively.[50 54] Ninety per cent of the elite club studies used a 'time-loss' injury definition. Of the 11 international data sets included in our analyses, 4 (36%) used a 'time-loss' injury definition and 7 (64%) used an 'all physical complaints' injury definition. As specified by Fuller *et al*,[39] we would endorse the comprehensive and transparent reporting of injury outcome metrics, categorised by injury definition to reflect the true nature of injuries incurred during training and match play.

Injury reporting mechanisms

Fuller *et al*[39] recommend that injury report forms should be completed by medical professionals after each recordable injury. The two amateur club studies in our review used a player self-report system to record injuries.[50 54] This is to be expected at the amateur level of the game due to the lack of medical resources available to teams. Seventy-per cent of the elite club studies used a medical staff registration system, 10% used a player self-report system, 10% used a player self-report and medical staff registration system, and 10% used a trainer, coach and medical staff registration system to record injuries (online supplemental files 3 and 8). All international studies used a medical staff registration system.

Study quality

The rationale for the development of the consensus statement on data collection procedures in studies of football (soccer) injuries was to enhance the scientific rigour of football injury surveillance studies.[39] By following the recommendations in the consensus statement, consistency in data collection is ensured, which allows for accurate comparisons to be made across injury surveillance studies from different geographical locations and levels of the game. More than 1 in 10 of the studies included in our review did not include a definition of injury (table 7). We suggest that sufficient data should be reported in studies to allow independent verification of the outcome metrics presented; in the case of IIR data, this would include the reporting of the number of injuries (eg, the number of injuries sustained during matches) and the total exposure hours (eg, number of match exposure hours).

Statistical analysis

There is evidence of considerable heterogeneity as measured by I^2, between the studies included in several of our meta-analyses ($I^2>75\%$, Wald χ^2 $p<0.05$). This suggests that a large proportion of variability in the IIR estimates is due to real study differences and not chance. This reflects the scatter of study IIR estimates with little overlap in their confidence intervals within some of the analysis models, as seen in online supplemental file 5. Tau estimates are a helpful absolute measure to understand the variance in the true IRR range around the summary/pooled IIR. Overall, when interpreting Tau estimates for the random-effects meta-analyses included in our review, it is clear that there is not a lot of variability in true IIR around the summary/pooled IIR (despite medium-to-high I^2 values).

Future directions

Randomised controlled trials (RCTs) are required to establish the efficacy of injury prevention and performance enhancement programmes in women's football.[67] However, it may be unrealistic to undertake high quality, methodologically rigorous RCTs in women's elite club football, due to the time, money, equipment and energy required, all of which can be compounded by difficulties in accessing players and coaches who are willing to engage in the research.[68] To overcome this, Minas *et al*[69] suggested that the development of a relevant evidence-base can be established using expert consensus techniques. McCall *et al*[70] undertook a Delphi survey of 21 experienced practitioners in the big-5 men's leagues in Europe (England, Germany, Spain, Italy, France), with the objective of informing muscle injury prevention strategies. A similar Delphi survey of experienced practitioners in women's elite club football would provide valuable insight in to current best practice and could help to inform key priorities for injury prevention in women's football. We also think it is critical that players and medical personnel involved in the different levels of senior women's football are consulted when developing consensus on the design and implementation of user friendly and pragmatic injury risk reduction systems.[71]

Including a generic injury prevention and performance enhancement programme (eg, FIFA 11+, Prevent Injury and Enhance Performance, Knäkontroll) in the training week for women's amateur club football seems like a prudent approach to take for all coaches at the amateur level of the game, due to the evidence supporting their use in adolescent and college-level female footballers.[67 72] At international level, the challenge is the integration of players from a variety of clubs in to a different training environment with the added complications of fixture congestion, travel and time-zone differences. In this environment it is critical that there are ongoing and clear communication lines between international and club coaching, medical and fitness staff.[73 74] Practical solutions to this challenging scenario involve collaboration between club and international teams' staff in relation to readiness to play and training status, overall load management, injury prevention and/or strength programmes, and nutrition strategies.[73 74]

Limitations

As part of our data extraction template, we only documented data related to location of injury stratified by main grouping and type of injury stratified by main grouping (online supplemental file 2). Future data aggregation studies should also include data related to location of injury stratified by category and type of injury stratified by category. The low number of studies included in the meta-analyses is explained by differences in injury and severity definitions and variations in data collection methods. The lack of data on number of days lost per injury within the included studies meant that it was not possible to report on injury burden.

CONCLUSIONS

When a 'time-loss' definition of injury is used, overall, match and training IIRs are similar between women's elite club football and women's international football. 'Time-loss' training IIRs in women's elite club football and women's international football are approximately 6–7 times lower than their equivalent match IIRs. Consideration should be given to the design of training sessions to ensure that players are sufficiently prepared for the physical demands of match play. Injuries to the lower limb, and head and neck have the

highest IIRs in both women's elite club football and women' international football. The prevention of lower limb joint and ligament and muscle, and tendon injuries should be a central focus of injury prevention interventions in senior women's football.

What is already known?

⇒ Injury in amateur club, elite club and international women's football is common.
⇒ Knee, ankle and thigh injuries are frequently injured locations in women's football.
⇒ Severe injuries to the lower extremity are incurred in women's football but it has not been possible to calculate injury burden in the majority of studies on women's football to date.

What are the new findings?

⇒ 'Time-loss' overall, match and training IIRs are similar between women's elite club football and women's international football.
⇒ Women's elite club football studies showed overall highest to lowest 'time-loss' IIRs by location main grouping as follows: lower limbs, head and neck, trunk, and upper limbs.
⇒ The injury types with the highest IIRs in women's elite club and international football are joint, ligament, contusion, muscle and tendon injuries.
⇒ Muscle and tendon injuries of the lower limb (and particularly the thigh) are a primary problem in women's elite club football.
⇒ Training 'time-loss' IIRs in women's elite club football and women's international football are approximately 6–7 times lower than their equivalent match IIRs.
⇒ The majority of injuries in women's international football are of minimal severity, whereas the IIRs of minimal, mild and moderate injuries in women's elite club football are similar.

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Contributors DH and ED are the guarantors of the review. ED developed the eligibility criteria. DH, FB and ED developed the search strategy. DH and ED performed abstract, title and full-text screening. Any discrepancies in study selection were arbitrated by MH. DH and ED performed data extraction, with any discrepancies arbitrated by MH. Statistical expertise was provided by FB and CB. Contextual expertise on football was provided by DH, SK, and MH. All authors approved the final protocol.

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Supplementary File 1. Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA-P) guideline.

#1a Identification:
Identify the report as a protocol of a systematic review.
Injury incidence rates in women's football: a systematic review and meta-analysis of prospective injury surveillance studies.

#1b Update:
If the protocol is for an update of a previous systematic review, identify as such.
N/A

#2 Registration:
If registered, provide the name of the registry (such as PROSPERO) and registration number.
This systematic review and meta-analysis will be registered at the International prospective register of systematic reviews (PROSPERO).

#3a Contact:
Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author.

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#3b Contributions:
Describe contributions of protocol authors and identify the guarantor of the review

Review team members and their organisational affiliations
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Daniel Horan and Eamonn Delahunt are the guarantors of the review. Eamonn Delahunt developed the eligibility criteria. Daniel Horan, Fionn Büttner and Eamonn Delahunt developed the search strategy. Daniel Horan and Eamonn Delahunt performed abstract, title and full-text screening. Any discrepancies in study selection were arbitrated by Martin Hägglund. Daniel Horan and Eamonn Delahunt performed data extraction, with any discrepancies arbitrated by Martin Hägglund. Statistical expertise was provided by Fionn Büttner and Catherine Blake. Contextual expertise on football was provided by Daniel Horan, Seamus Kelly and Martin Hägglund. All authors approved the final protocol.

#4 Amendments:
If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments.
N/A

#5a Sources:
Indicate sources of financial or other support for the review.
Daniel Horan is supported by the Irish Research Council Enterprise Partnership Scheme (Postgraduate) (Project ID: EPSPG/2019/543). The Irish Research Council's Enterprise Partnership Scheme is "a unique national initiative linking excellent researchers to enterprise. The scheme co-funds awardees to bring great research ideas into an enterprise with the support of a higher education institution". The Football Association of Ireland is the enterprise partner.

#5b Sponsor:
Provide name for the review funder and/or sponsor.
The Irish Research Council and the Football Association of Ireland funded this research.

Role of sponsor or funder: 5c
Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol.
Daniel Horan is the recipient of an Irish Research Council Enterprise Partnership Scheme (Postgraduate) award. This scheme provides funding for PhD students to undertake research with a specified enterprise partner; in this instance the enterprise partner is the Football Association of Ireland. Professor Eamonn Delahunt is designated as the Principal Investigator associated with this award and amongst other duties is responsible for overseeing the administration of the award budget. The Irish Research Council was not involved in any aspect of the project, such as the design of the project's protocol and analysis plan. The Irish Research Council will have no input on the interpretation or publication of the study results. The Football Association of Ireland was not involved in any aspect of the project, such as the design of the project's protocol and analysis plan. The Football Association of Ireland will have no input on the interpretation or publication of the study results.

#6 Describe the rationale for the review in the context of what is already known:
The protection of player health via the prevention of football-related injuries and illnesses are key policy concerns of Fédération Internationale de Football Association (FIFA) and Union des Associations Européennes de Football (UEFA). To date, a large majority of published research in football has been undertaken on the men's game. Presently, the quantity and quality of research related to the thematic focus of the protection of player health and the prevention of injuries in women's football, both nationally and internationally is limited. Thus, there is a critical need for research to inform future strategic policies in women's football. The aggregation of data on the epidemiology of injuries in senior women's football could be used to inform the future development and implementation of injury prevention strategies.

#7 Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO):
The aim of this systematic review and meta-analysis is to review the literature with the primary purpose of establishing injury incidence rates in senior women's football.

Population (P): Female football players participating in a senior women's football league (elite-level or amateur-level) or a senior women's international football tournament.

Intervention (I): In this case the intervention is actually an exposure. The exposure is considered as either of the following:
(1) participation in a senior women's football league (elite-level or amateur-level) for a minimum duration of one season
(2) participation in a senior women's international football tournament

Comparator (C): Not applicable.

Outcome (O): The outcome measure of interest is injury (i.e. a player has sustained an injury). We will use injury incidence rate as the primary outcome metric to quantify "injury". Injury incidence rate will be calculated per 1000 units of exposure (i.e. per 1000 hours OR per 1000 athlete-exposures). Athlete-exposure is defined as 1 athlete participating in 1 match or training session.

$$Injury\ incidence = \frac{\Sigma\ injuries}{\Sigma\ exposure}$$

$$Injury\ incidence\ rate\ = (\frac{\Sigma\ injuries}{\Sigma\ exposure})\ x\ 1000\ (hours\ OR\ athlete\ exposures)$$

Where possible we will calculate the following outcome metrics:
(1) overall injury incidence rate
(2) match injury incidence rate
(3) training injury incidence rate
These outcome metrics (overall-, match- and training injury incidence rates) will also be calculated for level of play, as well as location of injury, type of injury, and severity of injury.

Level of play: The level of play will be stratified into the following categories: (1) international – UEFA defines international football as a match between two national teams composed of the best eligible players (https://www.uefa.com/insideuefa/dictionary/index.html); (2) elite – UEFA defines elite-level football as the highest national football league for women (Ekstrand et al, 2011); (3) amateur – any league below the highest national football league. The levels of play are outlined in Table 1.

Location of injury: The location of injury will be quantified according to the recommendations of Fuller et al (2006); see Table 2.

Type of injury: The type of injury will be quantified according to the recommendations of Fuller et al (2006); see Table 3.

Severity of injury: The severity of injury will be quantified according to the recommendations of Ekstrand et al (2011); see Table 4.

#8 Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review:
To be deemed eligible for inclusion, studies were required to fulfil the following criteria (framed according to PICO).

Population (P): The study had to include:
(1) female football players participating in a senior women's football league (elite-level or amateur-level)
(2) female football players participating in a senior women's international football tournament.

Intervention (I): In this case the intervention is actually an exposure. The exposure is considered as either of the following:
(1) participation in a senior women's football league (elite-level or amateur-level) for a minimum duration of one season
(2) participation in a senior women's international football tournament

Comparator (C): Not applicable.

Outcome (O): The outcome measure of interest is injury (i.e. a player has sustained an injury). We will use injury incidence rate as the primary outcome metric to quantify "injury". The study had to report Injury incidence rate(s) or provide sufficient data from which this outcome metric could be calculated through standardised equations (see #7)

Additional criteria: The study had to:
(1) be a full text article published in a peer-reviewed journal before August 2019
(2) be a prospective injury surveillance study

#9 Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage:
The search strategy will be applied across electronic bibliographic and grey literature databases; MEDLINE via PubMed; EMBASE via Ovid; CINAHL via Ebsco; and Web of Science. The search terms will be mapped to Medical Subject Headings (MeSH) terms where possible. Search terms will be applied from conception of each database to August 2019. The reference lists of included articles will be hand searched to identify other potentially relevant articles.

#10 Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated:
The following is the example of the search conducted on the PubMed database:
("women"[MeSH Terms] OR "women"[All Fields]) AND ("football"[MeSH Terms] OR "football"[All Fields]) OR ("soccer"[MeSH Terms] OR "soccer"[All Fields]) AND ("wounds and injuries"[MeSH Terms] OR ("wounds"[All Fields] AND "injuries"[All Fields]) OR "wounds and injuries"[All Fields] OR "injury"[All Fields])

#11a Describe the mechanism(s) that will be used to manage records and data throughout the review:
Studies will be imported from EndNote into the systematic review software, 'Rayyan'. We will use Rayyan to identify, screen (title, abstract, and full-text articles), and include eligible records. We will export included studies to an Endnote folder for data extraction.

#11b State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis):
Study selection will be performed by two reviewers (DH and ED) independently . A third reviewer (MH) will be consulted to resolve disagreements amongst these reviewers and to facilitate consensus. The two reviewers will independently screen the titles and abstracts of

the identified peer-reviewed articles to assess eligibility for inclusion in this review. Studies will be considered for inclusion based on their fulfilment of pre-specified eligibility criteria. Full-length texts of remaining peer-reviewed articles will be sought and reviewed in full to determine eligibility if reviewers are uncertain about their eligibility from title and abstract screening.

#11c Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators:
A standardized data extraction sheet (created in Microsoft Excel) will be used to extract data. Data extraction will be performed by two reviewers (Daniel Horan and Eamonn Delahunt) independently . A third reviewer (Martin Hägglund) will be consulted to resolve disagreements amongst these reviewers and to facilitate consensus.

#12 List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications:
Data will be organized in the following manner:

Study Characteristics:
(1) study lead author
(2) study title
(3) journal
(4) year of publication
(5) study design

Participant Characteristics:
(1) country
(2) tournament
(3) level of play (mapped to UEFA standardized levels)
(4) number of clubs/teams enrolled (n = …)
(5) number of participants enrolled (n = …)
(6) age of participants (years)
(7) body mass of participants (kg)
(8) playing experience of participants (years)
(9) hours per week of training (hours)
(10) number of matches per season/tournament (n = …)

Study Outcomes:
(1) length of season/tournament (weeks)
(2) number of seasons (n = …)
(3) injury definition (as per Fuller et al, 2006)
(4) mechanism of injury reporting (medical personnel; self-reported)
(5) number of clubs/teams included in reporting (n = …);
(6) number of participants included in reporting (n = …);
(7) total number of injuries (n = …)

Injury Incidence rate:
(1) season/tournament overall injury incidence rate (per 1000 hours OR per 1000 athlete-exposures)
(2) season/tournament match injury incidence rate (per 1000 hours OR per 1000 athlete-exposures)
(3) season/tournament training injury incidence rate (per 1000 hours OR per 1000 athlete-exposures)

* injury incidence rate(s) will be calculated for: level of play; location of injury; type of injury; severity of injury

#13 List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale:
The primary outcome measure of interest is injury (i.e. a player has sustained an injury). We will use injury incidence rate as the primary outcome metric to quantify "injury".
Injury incidence rate will be calculated per 1000 units of exposure (i.e. per 1000 hours OR per 1000 athlete-exposures). Athlete-exposure is defined as 1 athlete participating in 1 match or training session.

Where possible we will calculate the following outcome metrics:
(1) overall injury incidence rate
(2) match injury incidence rate
(3) training injury incidence rate
These outcome metrics (overall-, match- and training injury incidence rates) will also be calculated for level of play, as well as location of injury, type of injury, and severity of injury.

Level of play: The level of play will be stratified into the following categories:
(1) international – UEFA defines international football as a match between two national teams composed of the best eligible players (https://www.uefa.com/insideuefa/dictionary/index.html);
(2) elite – UEFA defines elite-level football as the highest national football league for women (Ekstrand et al, 2011);
(3) amateur – any league below the highest national football league. The levels of play are outlined in Table 1.

Location of injury: The location of injury will be quantified according to the recommendations of Fuller et al (2006); see Table 2.

Type of injury: The type of injury will be quantified according to the recommendations of Fuller et al (2006); see Table 3.

Severity of injury: The severity of injury will be quantified according to the recommendations of Ekstrand et al (2011); see Table 4.

#14 Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis:
Presently, we are unaware of any tools available to correctly assess risk of bias in prospective injury surveillance studies.

#15a Describe criteria under which study data will be quantitatively synthesised:
We will perform a meta-analysis when relevant data have sufficient conceptual and methodological homogeneity between studies to permit quantitative aggregation. This decision will be made by the authors based on their interpretation of perceived differences between study subpopulations (e.g., international, elite, and amateur), exposure type, and outcome metrics reported, as recommended by Higgins and Green (2008) and Borenstein et al (2009).

Our decision to perform a meta-analysis will not be determined by threshold estimates of heterogeneity (e.g., I^2 statistic to represent the proportion of observed dispersion that is real), or any estimate of heterogeneity (e.g., using Cochran's Q test). (Higgins et al, 2001; Borenstein et al, 2009). Due to the selection criteria of our systematic review, we anticipate that the review population and exposure characteristics will be sufficiently homogeneous across studies to permit meta-analysis. Where different injury outcome metrics are reported between eligible studies, we will convert reported injury outcome metrics to a common effect size, where possible (e.g., injury incidence rate per 1000 hours).

#15b If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I2, Kendall's τ):

We will perform an inverse-variance, random-effects meta-analysis, using the 'metafor' package in RStudio (Viechtbauer, 2010), to calculate a pooled injury incidence rate and 95% confidence intervals. A random-effects model will be selected to reflect that no common underlying injury incidence rate exists across all studies, but rather that injury incidence rate differs from study to study depending on population characteristics (e.g., age and level of play).

We will identify and quantify heterogeneity to interpret the patterns of study effect estimates (i.e., injury incidence rate) and partition true variation in study effect sizes from random variation. We will quantify Cochran's Q value to reflect total dispersion, Kendall's Tau to estimate the standard deviation of true effects and interpret the distribution of true effects, and an I^2 statistic to estimate the ratio of true heterogeneity to total observed variation.

#15c Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression):

We will perform a subgroup analysis to assess the relationship between level of play (i.e., international, elite, and amateur) and pooled injury incidence rate.

#15d If quantitative synthesis is not appropriate, describe the type of summary planned:

If meta-analysis is not appropriate due to excessive heterogeneity, we will descriptively summarise and report the characteristics and results of included studies, systematically, in order of study:

1. sub-population;
2. exposure;
3. outcome metric, and;
4. methodology

Additionally, we will visually present injury outcome metrics in a forest plot, if possible, without quantitatively synthesising studies.

#16 Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies):
Presently, we are unaware of any tools available to correctly assess risk of bias in prospective injury surveillance studies.

#17 Describe how the strength of the body of evidence will be assessed (such as GRADE):
This will not be possible, as presently we are unaware of any tools available to correctly assess risk of bias in prospective injury surveillance studies.

References

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https://www.uefa.com/insideuefa/dictionary/index.html

Table 1. Level of play.

Level of play	Definition
International	UEFA defines international football as a *"match between two national teams composed of the best eligible players."*[1]
Elite	the highest national football league[2]
Amateur	any league below the highest national football league[3]

[1] https://www.uefa.com/insideuefa/dictionary/index.html
[2] Ekstrand et al (2011)
[3] By default based upon the definition provided by Ekstrand et al (2011)

Table 2. Location of injury.

Main grouping	Category
Head and neck	• Head and face • Neck/cervical spine
Upper limbs	• Shoulder/clavicle • Upper arm • Elbow • Forearm • Wrist • Hand/finger/thumb
Trunk	• Sternum/ribs/upper back
Lower limbs	• Hip/groin • Thigh • Knee • Lower leg/Achilles tendon • Ankle • Foot/toe

Table 3. Type of injury.

Main grouping	Category
Fractures and bone stress	• Fracture • Other bone injuries
Joint (non-bone) and ligaments	• Dislocation/subluxation • Sprain/ligament injury • Lesion of meniscus or cartilage
Muscle and tendon	• Muscle rupture/tear/strains/cramps • Tendon injury/rupture/tendinosis/bursitis
Contusion	• Haematoma/contusion/bruise
Laceration and skin lesion	• Abrasion • Laceration
Central/peripheral nervous system	• Concussion (with or without loss of consciousness) • Nerve injury
Other injuries	• Dental injuries • Other injuries

Table 4. Severity of injury.

Level of severity	Definition
Slight	Injury causing absence from training and match play for <1 day
Minimal	Injury causing absence 1-3 days from training and match play
Mild	Injury causing absence 4-7 days from training and match play
Moderate	Injury causing absence 8-28 days from training and match play
Severe	Injury causing absence >28 days from training and match play

All definitions were based upon those utilised by Ekstrand et al (2011)

Supplementary File 2.

Table 1. Level of play.

Level of play	Definition
International	UEFA defines international football as a *"match between two national teams composed of the best eligible players."*[1]
Elite	the highest national football league[2]
Amateur	any league below the highest national football league[3]

[1] https://www.uefa.com/insideuefa/dictionary/index.html
[2] Ekstrand et al (2011)
[3] By default based upon the definition provided by Ekstrand et al (2011)

Ekstrand J, Hägglund M, Fuller CW. Comparison of injuries sustained on artificial turf and grass by male and female elite football players. *Scand J Med Sci Sport*. 2011;21:824-832.

Table 2. Location of injury.

Main grouping	Category
Head and neck	• Head and face • Neck/cervical spine
Upper limbs	• Shoulder/clavicle • Upper arm • Elbow • Forearm • Wrist • Hand/finger/thumb
Trunk	• Sternum/ribs/upper back
Lower limbs	• Hip/groin • Thigh • Knee • Lower leg/Achilles tendon • Ankle • Foot/toe

Table 3. Type of injury.

Main grouping	Category
Fractures and bone stress	• Fracture • Other bone injuries
Joint (non-bone) and ligaments	• Dislocation/subluxation • Sprain/ligament injury • Lesion of meniscus or cartilage
Muscle and tendon	• Muscle rupture/tear/strains/cramps • Tendon injury/rupture/tendinosis/bursitis
Contusion	• Haematoma/contusion/bruise
Laceration and skin lesion	• Abrasion • Laceration
Central/peripheral nervous system	• Concussion (with or without loss of consciousness) • Nerve injury
Other injuries	• Dental injuries • Other injuries

Table 4. Severity of injury.

Level of severity	Definition
Slight	Injury causing absence from training and match play for <1 day
Minimal	Injury causing absence 1-3 days from training and match play
Mild	Injury causing absence 4-7 days from training and match play
Moderate	Injury causing absence 8-28 days from training and match play
Severe	Injury causing absence >28 days from training and match play

All definitions were based upon those utilised by Ekstrand (2011)

Ekstrand J, Hägglund M, Fuller CW. Comparison of injuries sustained on artificial turf and grass by male and female elite football players. *Scand J Med Sci Sport*. 2011;21:824-832.

Supplementary File 3.

Table 1. Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller et al, 2006)

	Study design	Duration of study
McNoe & Chalmers (2010)	✓	✓
Jacobson & Tegner (2006)	✓	✓
Ibikunle et al (2019)	✓	✓
Babwah (2014)	✓	✓
Nilstad et al (2014)	✓	✓
Giza et al (2012)	✓	✓
Ekstrand et al (2011)	✓	✓
Gaulrapp et al (2010)	✓	✓
Hägglund et al (2009)	✓	✓
Tegnander et al (2008)	✓	✓
Jacobson & Tegner (2007)	✓	✓
Faude et al (2005)	✓	✓
Hägglund et al (2009)	✓	✓
Waldén et al (2007)	✓	✓
Junge & Dvorak (2007)	✓	✓
Junge et al (2006)	✓	✓
Junge et al (2004)	✓	✓

Table 2. Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller et al, 2006)

	Study population						
	Organisational setting	**Geographical location**	**Number of teams**	**Number of players**	**Age range of players**	**Gender of players**	**Level of play**
McNoe & Chalmers (2010)	✓	✓	✗	✓	✓	✓	✓
Jacobson & Tegner (2006)	✓	✓	✓	✓	✓	✓	✓
Ibikunle et al (2019)	✓	✓	✓	✓	✓	✓	✓
Babwah (2014)	✓	✓	✓	✗	✗	✓	✓
Nilstad et al (2014)	✓	✓	✓	✓	✗	✓	✓
Giza et al (2012)	✓	✓	✓	✓	✗	✓	✓
Ekstrand et al (2011)	✓	✓	✓	✓	✓	✓	✓
Gaulrapp et al (2010)	✓	✓	✓	✓	✓	✓	✓
Hägglund et al (2009)	✓	✓	✓	✓	✓	✓	✓
Tegnander et al (2008)	✓	✓	✓	✓	✓	✓	✓
Jacobson & Tegner (2007)	✓	✓	✓	✓	✓	✓	✓
Faude et al (2005)	✓	✓	✓	✓	✓	✓	✓
Hägglund et al (2009)	✓	✓	✓	✓	✓	✓	✓
Waldén et al (2007)	✓	✓	✓	✓	✗	✓	✓
Junge & Dvorak (2007)	✓	✓	✗	✗	✗	✓	✓
Junge et al (2006)	✓	✓	✗	✗	✗	✓	✓
Junge et al (2004)	✓	✓	✗	✗	✗	✓	✓

Table 3. Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller et al, 2006)

	Medical personnel involved	Frequency of recording injuries	Frequency of recording exposure data	Training to improve the quality of data collection
McNoe & Chalmers (2010)	✖	✓	✓	✓
Jacobson & Tegner (2006)	✓	✓	✓	✓
Ibikunle et al (2019)	✓	✓	✖	✓
Babwah (2014)	✓	✓	✖	✖
Nilstad et al (2014)	✓	✓	✓	✓
Giza et al (2012)	✓	✓	✖	✖
Ekstrand et al (2011)	✓	✓	✓	✓
Gaulrapp et al (2010)	✓	✓	✓	✖
Hägglund et al (2009)	✓	✖	✓	✓
Tegnander et al (2008)	✓	✖	✖	✖
Jacobson & Tegner (2007)	✖	✓	✓	✓
Faude et al (2005)	✓	✓	✓	✖
Hägglund et al (2009)	✓	✓	✓	✓
Waldén et al (2007)	✓	✓	✓	✓
Junge & Dvorak (2007)	✓	✓	✓	✓
Junge et al (2006)	✓	✓	✓	✓
Junge et al (2004)	✓	✓	✓	✖

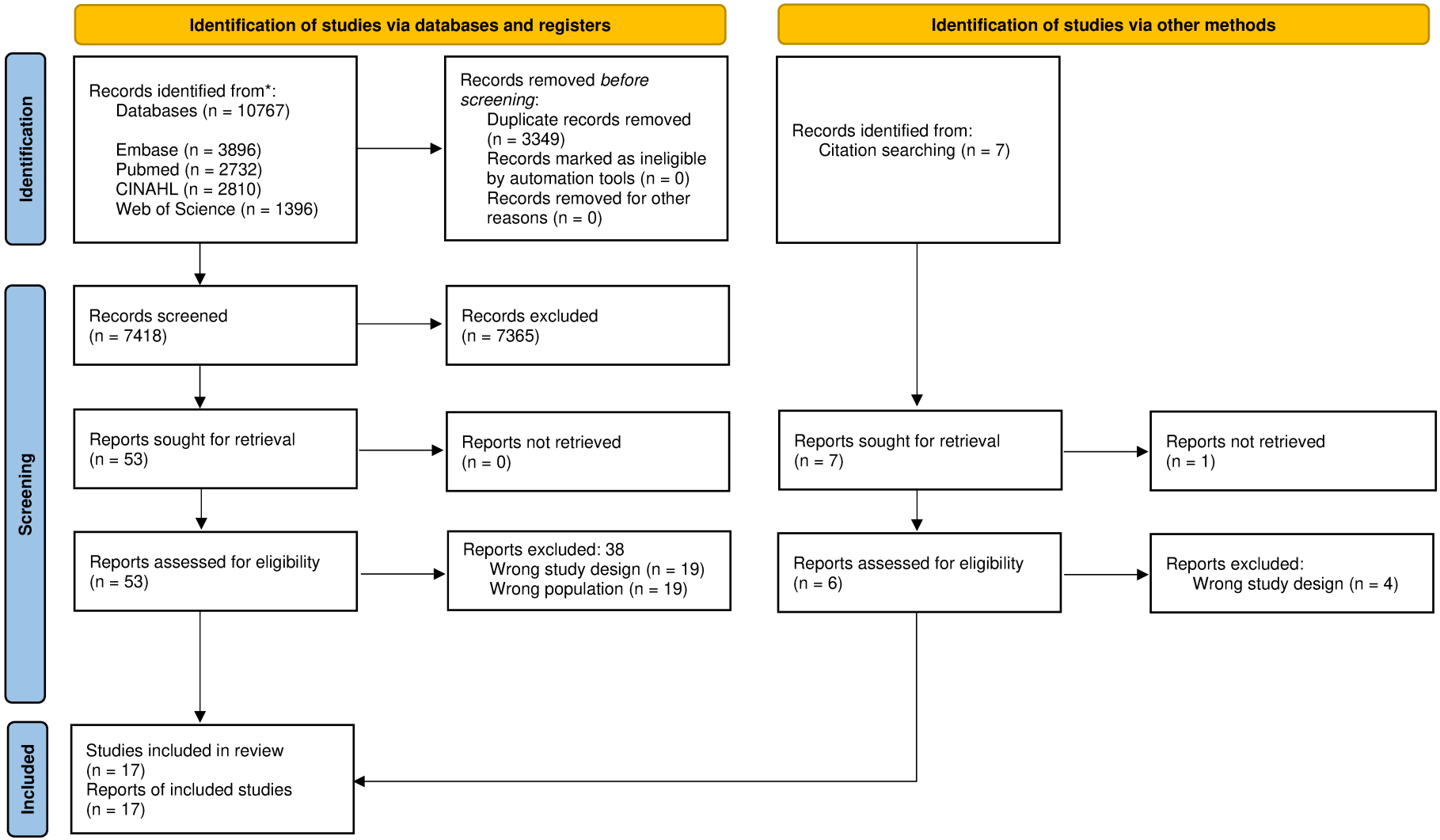
Table 4. Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller et al, 2006)

	Definition of injury	Definition of exposure
McNoe & Chalmers (2010)	✓	✓
Jacobson & Tegner (2006)	✓	✓
Ibikunle et al (2019)	✓	✘
Babwah (2014)	✓	✘
Nilstad et al (2014)	✓	✓
Giza et al (2012)	✘	✓
Ekstrand et al (2011)	✓	✓
Gaulrapp et al (2010)	✓	✘
Hägglund et al (2009)	✓	✓
Tegnander et al (2008)	✘	✓
Jacobson & Tegner (2007)	✓	✓
Faude et al (2005)	✓	✓
Hägglund et al (2009)	✓	✓
Waldén et al (2007)	✓	✓
Junge & Dvorak (2007)	✓	✓
Junge et al (2006)	✓	✘
Junge et al (2004)	✓	✓

Table 5. Checklist of issues that should be included in reports of studies of football injuries (amended from Fuller et al, 2006)

	Number of match exposures	Number of match injuries	Number of training exposures	Number of training injuries
McNoe & Chalmers (2010)	✖	✓	✖	✓
Jacobson & Tegner (2006)	✖	✓	✖	✓
Ibikunle et al (2019)	✓	✓	✓	✓
Babwah (2014)	✓	✓	✖	✖
Nilstad et al (2014)	✖	✓	✖	✓
Giza et al (2012)	✖	✖	✖	✖
Ekstrand et al (2011)	✓	✓	✓	✓
Gaulrapp et al (2010)	✖	✓	✖	✓
Hägglund et al (2009)	✓	✓	✓	✓
Tegnander et al (2008)	✓	✓	✓	✓
Jacobson & Tegner (2007)	✓	✓	✓	✓
Faude et al (2005)	✖	✖	✖	✖
Hägglund et al (2009)	✓	✓	✓	✓
Waldén et al (2007)	✓	✓	✓	✓
Junge & Dvorak (2007)	✖	✓	✖	✖
Junge et al (2006)	✓	✓	✖	✖
Junge et al (2004)	✓	✓	✖	✖

Supplementary File 4.



Supplementary File 5.

Table 1. Women's elite football injury surveillance studies: overall, match, & training injury incidence rates (per 1,000 hours of exposure).

	Overall	Match	Training
Ibikunle et al (2019)	19.17 (14.40 to 23.94)	55.56 (36.60 to 74.51)	10.98 (6.99 to 14.98)
Babwah (2014)		27.60 (17.00 to 38.20)*	
Nilstad et al (2014): self-reported		18.60 (14.70 to 22.50)*	3.70 (3.00 to 4.30)*
Nilstad et al (2014): medical staff		5.40 (3.80 to 7.00)*	2.20 (1.50 to 2.80)*
Ekstrand et al (2011): grass	5.79 (4.28 to 7.29)	12.51 (8.53 to 16.49)	2.79 (1.54 to 4.04)
Ekstrand et al (2011): artificial turf	4.30 (3.65 to 4.96)	14.88 (11.32 to 18.45)	2.92 (2.33 to 3.48)
Gaulrapp et al (2010)	3.26 (2.85 to 3.67)	18.49 (15.58 to 21.40)	1.36 (1.08 to 1.64)
Hägglund et al (2009)	5.52 (4.90 to 6.15)	16.13 (13.29 to 18.97)	3.77 (3.21 to 4.32)
Tegnander et al (2008)	6.17 (5.29 to 7.05)	24.30 (19.35 to 29.34)	3.71 (2.98 to 4.44)
Jacobson & Tegner (2007)	4.45 (3.89 to 5.03)	13.90 (11.37 to 16.43)	2.70 (2.06 to 3.34)
Faude et al (2005)	6.80 (5.94 to 7.66)		

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).
* Studies not included in the meta-analysis due to data required for statistical aggregation (e.g., number of injuries; total of exposure hours; standard error) not being reported or calculable.

Table 2a. Women's elite football injury surveillance studies: overall injury incidence rates (per 1,000 hours of exposure) stratified by location of injury.

	Head & Neck	Upper Limbs	Trunk	Lower Limbs
Ibikunle et al (2019)				
Babwah (2014)				
Nilstad et al (2014): self-reported				
Nilstad et al (2014): medical staff				
Ekstrand et al (2011): grass	0.61 (0.12 to 1.10)	0.30 (-0.04 to 0.65)	0.20 (-0.08 to 0.48)	4.67 (3.32 to 6.02)
Ekstrand et al (2011): artificial turf	0.29 (-0.37 to 0.95)	0.16 (-0.33 to 0.64)	0.13 (-0.32 to 0.57)	3.71 (1.33 to 6.09)
Gaulrapp et al (2010)				
Hägglund et al (2009)	0.22 (-0.47 to 0.91)	0.11 (-0.38 to 0.60)	0.50 (-0.54 to 1.53)	5.13 (1.82 to 8.45)
Tegnander et al (2008)	0.46 (0.22 to 0.70)	0.29 (0.10 to 0.49)	0.42 (0.19 to 0.66)	5.00 (4.21 to 5.79)
Jacobson & Tegner (2007)		0.08 (0.00 to 0.15)		3.65 (3.14 to 4.16)
Faude et al (2005)	0.45 (0.23 to 0.67)	0.37 (0.17 to 0.57)	0.51 (0.27 to 0.74)	5.47 (4.70 to 6.24)

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 2b. Women's elite football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by location of injury.

	Head & Neck	Upper Limbs	Trunk	Lower Limbs
Ibikunle et al (2019)				
Babwah (2014)				
Nilstad et al (2014): self-reported				
Nilstad et al (2014): medical staff				
Ekstrand et al (2011): grass	1.32 (0.03 to 2.61)	0.33 (-0.32 to 0.97)	1.11 (0.14 to 2.08)	10.86 (7.16 to 14.57)
Ekstrand et al (2011): artificial turf	0.89 (0.02 to 1.76)	0.22 (-0.21 to 0.66)	0.00	12.44 (9.18 to 15.70)
Gaulrapp et al (2010)				
Hägglund et al (2009)				
Tegnander et al (2008)				
Jacobson & Tegner (2007)		0.24 (-0.09 to 0.57)		11.26 (8.99 to 13.54)
Faude et al (2005)				

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 2c. Women's elite football injury surveillance studies: training injury incidence rates (per 1,000 hours of exposure) stratified by location of injury.

	Head & Neck	Upper Limbs	Trunk	Lower Limbs
Ibikunle et al (2019)				
Babwah (2014)				
Nilstad et al (2014): self-reported				
Nilstad et al (2014): medical staff				
Ekstrand et al (2011): grass	0.29 (-0.11 to 0.70)	0.29 (-0.11 to 0.70)	0.29 (-0.11 to 0.70)	1.91 (0.87 to 2.95)
Ekstrand et al (2011): artificial turf	0.21 (0.05 to 0.36)	0.15 (0.02 to 0.28)	0.00	2.55 (2.00 to 3.09)
Gaulrapp et al (2010)				
Hägglund et al (2009)				
Tegnander et al (2008)				
Jacobson & Tegner (2007)		0.04 (-0.02 to 0.11)		2.23 (1.79 to 2.67)
Faude et al (2005)				

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 3a. Women's elite football injury surveillance studies: overall injury incidence rates (per 1,000 hours of exposure) stratified by type of injury.

	Fracture & Bone Stress	Joint & Ligaments	Muscle & Tendon	Contusion	Laceration & Skin Lesion	CNS/PNS	Other Injuries
Ibikunle et al (2019)	2.47 (0.76 to 4.19)	6.80 (3.96 to 9.65)	8.08 (4.95 to 11.13)	0.00	1.24 (0.02 to 2.45)	0.31 (-0.30 to 0.92)	0.31 (-0.30 to 0.92)
Babwah (2014)							
Nilstad et al (2014): self-reported							
Nilstad et al (2014): medical staff							
Ekstrand et al (2011): grass	0.20 (-0.08 to 0.48)	1.62 (0.83 to 2.42)	2.03 (1.14 to 2.92)	1.22 (0.53 to 1.91)	0.00	0.41 (0.01 to 0.80)	0.30 (-0.04 to 0.65)
Ekstrand et al (2011): artificial turf	0.20 (-0.34 to 0.71)	1.76 (0.12 to 0.34)	1.30 (-0.11 to 2.70)	0.70 (-0.33 to 1.73)	0.03 (-0.17 to 0.22)	0.18 (-0.34 to 0.71)	0.13 (-0.32 to 0.57)
Gaulrapp et al (2010)							
Hägglund et al (2009)							
Tegnander et al (2008)							
Jacobson & Tegner (2007)							
Faude et al (2005)							

Values are IIR (95% CI).

Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 3b. Women's elite football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by type of injury.

	Fracture & Bone Stress	Joint & Ligaments	Muscle & Tendon	Contusion	Laceration & Skin Lesion	CNS/PNS	Other Injuries
Ibikunle et al (2019)							
Babwah (2014)							
Nilstad et al (2014): self-reported							
Nilstad et al (2013): medical staff							
Ekstrand et al (2011): grass	0.33 (-0.32 to 0.97)	4.94 (2.44 to 7.44)	2.96 (1.03 to 4.90)	3.23 (1.25 to 5.33)	0.00	0.99 (-0.13 to 2.10)	0.00
Ekstrand et al (2011): artificial turf	0.00	5.55 (3.38 to 7.73)	3.55 (1.81 to 5.30)	3.55 (1.81 to 5.30)	0.22 (-0.21 to 0.66)	0.89 (0.49 to 1.29)	0.89 (0.49 to 1.29)
Gaulrapp et al (2010)							
Hägglund et al (2009)							
Tegnander et al (2008)							
Jacobson & Tegner (2007)							
Faude et al (2005)							

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 3c. Women's elite football injury surveillance studies: training injury incidence rates (per 1,000 hours of exposure) stratified by type of injury.

	Fracture & Bone Stress	Joint & Ligaments	Muscle & Tendon	Contusion	Laceration & Skin Lesion	CNS/PNS	Other Injuries
Ibikunle et al (2019)							
Babwah (2014)							
Nilstad et al (2014): self-reported							
Nilstad et al (2013): medical staff							
Ekstrand et al (2011): grass	0.15 (-0.14 to 0.43)	0.15 (-0.14 to 0.43)	1.62 (0.66 to 2.57)	0.29 (-0.11 to 0.70)	0.00	0.15 (-0.14 to 0.43)	0.44 (-0.06 to 0.94)
Ekstrand et al (2011): artificial turf	0.21 (0.05 to 0.36)	1.26 (0.89 to 1.64)	1.00 (0.66 to 1.33)	0.32 (0.13 to 0.51)	0.00	0.09 (-0.01 to 0.19)	0.03 (-0.03 to 0.09)
Gaulrapp et al (2010)							
Hägglund et al (2009)							
Tegnander et al (2008)							
Jacobson & Tegner (2007)							
Faude et al (2005)							

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 4a. Women's elite football injury surveillance studies: overall injury incidence rates (per 1,000 hours of exposure) stratified by severity of injury.

	Slight (<1 day)	Minimal (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)
Ibikunle et al (2019)					
Babwah (2014)					
Nilstad et al (2014): self-reported					
Nilstad et al (2013): medical staff					
Ekstrand et al (2011): grass	0.00	1.83 (0.98 to 2.67)	1.42 (0.68 to 2.17)	1.62 (0.83 to 2.42)	0.91 (0.31 to 1.51)
Ekstrand et al (2011): artificial turf	0.03 (-0.02 to 0.08)	1.27 (0.92 to 1.63)	1.25 (0.89 to 1.60)	1.27 (0.92 to1.63)	0.49 (0.27 to 0.71)
Gaulrapp et al (2010)					
Hägglund et al (2009)		1.40 (1.09 to 1.72)	1.55 (1.22 to 1.88)	1.88 (1.52 to 2.25)	0.68 (0.46 to 0.90)
Tegnander et al (2008)					
Jacobson & Tegner (2007)		0.77 (0.54 to 1.01)	0.98 (0.71 to 1.24)	1.73 (1.38 to 2.08)	0.98 (0.71 to 1.24)
Faude et al (2005)					

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 4b. Women's elite football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by severity of injury.

	Slight (<1 day)	Minimal (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)
Ibikunle et al (2019)					
Babwah (2014)					
Nilstad et al (2014): self-reported					
Nilstad et al (2013): medical staff					
Ekstrand et al (2011): grass	0.00	3.95 (1.72 to 6.18)	2.63 (0.81 to 4.46)	2.96 (1.03 to 4.90)	2.96 (1.03 to 4.90)
Ekstrand et al (2011): artificial turf	0.00	4.89 (2.84 to 6.93)	4.00 (2.15 to 5.85)	4.44 (2.50 to 6.39)	1.55 (0.40 to 2.71)
Gaulrapp et al (2010)					
Hägglund et al (2009)					
Tegnander et al (2008)					
Jacobson & Tegner (2007)					
Faude et al (2005)					

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 4c. Women's elite football injury surveillance studies: training injury incidence rates (per 1,000 hours of exposure) stratified by severity of injury.

	Slight (<1 day)	Minimal (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)
Ibikunle et al (2019)					
Babwah (2014)					
Nilstad et al (2014): self-reported					
Nilstad et al (2013): medical staff					
Ekstrand et al (2011): grass	0.00	0.88 (0.18 to 1.59)	0.88 (0.18 to 1.59)	1.03 (0.27 to 1.79)	0.00
Ekstrand et al (2011): artificial turf	0.03 (-0.03 to 0.08)	0.79 (0.49 to 1.09)	0.88 (0.57 to 1.20)	0.85 (0.54 to 1.16)	0.35 (0.15 to 0.55)
Gaulrapp et al (2010)					
Hägglund et al (2009)					
Tegnander et al (2008)					
Jacobson & Tegner (2007)					
Faude et al (2005)					

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 5. Women's international football injury surveillance studies: overall, match, & training injury incidence rates (per 1,000 hours of exposure).

	Overall	Match	Training
Hägglund et al (2009) U-19 European Championship 2006	13.47 (7.97 to 18.98)	28.17 (13.41 to 42.92)	7.44 (2.58 to 12.30)
Hägglund et al (2009) U-19 European Championship 2007	8.53 (3.70 to 13.35)	21.96 (8.98 to 34.93)	1.10 (-1.06 to 3.27)
Hägglund et al (2009) U-19 European Championship 2008	4.89 (1.50 to 8.28)	11.67 (2.33 to 21.01)	1.78 (-0.69 to 4.26)
Junge et al (2004) World Cup 1999			
Junge & Dvorak (2007) World Cup 2003			
Junge et al (2004) Olympic Games 2000			
Junge et al (2006) Olympic Games 2004			
Junge & Dvorak (2007) U-19 World Championship 2002			
Junge & Dvorak (2007) U-19 World Championship 2004			
Junge & Dvorak (2007) U-20 World Championship 2006			
Waldén (2007) European Championship 2005	9.88 (5.32 to 14.45)	29.59 (14.61 to 44.56)	2.28 (-0.30 to 4.87)

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 6. Women's international football injury surveillance studies: overall, match, & training injury incidence rates (per 1,000 hours of exposure).

	Overall	Match	Training
Hägglund et al (2009) U-19 European Championship 2006			
Hägglund et al (2009) U-19 European Championship 2007			
Hägglund et al (2009) U-19 European Championship 2008			
Junge et al (2004) World Cup 1999		38.70 (24.83 to 52.49)	
Junge & Dvorak (2007) World Cup 2003		52.00 (38.00 to 66.00)	
Junge et al (2004) Olympic Games 2000		64.64 (42.25 to 87.05)	
Junge et al (2006) Olympic Games 2004		70.00 (50.00 to 90.00)	
Junge & Dvorak (2007) U-19 World Championship 2002		85.00 (65.00 to 105.00)	
Junge & Dvorak (2007) U-19 World Championship 2004		68.00 (50.00 to 85.00)	
Junge & Dvorak (2007) U-20 World Championship 2006		89.00 (71.00 to 107.00)	
Waldén (2007) European Championship 2005			

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using an **all physical complaints definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 7. Women's international football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by location of injury.

	Head & Neck	Upper Limbs	Trunk	Lower Limbs
Hägglund et al (2009) U-19 European Championship 2006				
Hägglund et al (2009) U-19 European Championship 2007				
Hägglund et al (2009) U-19 European Championship 2008				
Junge et al (2004) World Cup 1999				
Junge & Dvorak (2007) World Cup 2003				
Junge et al (2004) Olympic Games 2000	16.16 (4.96 to 27.36)	6.06 (-0.80 to 12.92)	2.02 (-1.94 to 5.98)	34.34 (18.02 to 50.67)
Junge et al (2006) Olympic Games 2004	10.88 (-1.68 to 23.44)	4.66 (-0.61 to 9.94)	6.22 (0.12 to 12.31)	48.17 (31.22 to 65.13)
Junge & Dvorak (2007) U-19 World Championship 2002				
Junge & Dvorak (2007) U-19 World Championship 2004				
Junge & Dvorak (2007) U-20 World Championship 2006				
Waldén (2007) European Championship 2005				

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using an **all physical complaints definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 8. Women's international football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by type of injury.

	Fracture & Bone Stress	Joint & Ligaments	Muscle & Tendon	Contusion	Laceration & Skin Lesion	CNS/PNS	Other Injuries
Hägglund et al (2009) U-19 European Championship 2006							
Hägglund et al (2009) U-19 European Championship 2007							
Hägglund et al (2009) U-19 European Championship 2008							
Junge et al (2004) World Cup 1999							
Junge & Dvorak (2007) World Cup 2003							
Junge et al (2004) Olympic Games 2000	0.00	8.08 (0.16 to 16.00)	16.16 (4.96 to 27.36)	4.04 (-1.56 to 9.64)	8.08 (0.16 to 16.00)	4.04 (-1.56 to 9.64)	0.00
Junge et al (2006) Olympic Games 2004	1.55 (-1.49 to 4.60)	23.31 (11.51 to 35.11)	6.21 (0.12 to 12.31)	24.85 (12.68 to 27.05)	0.00	3.11 (1.20 to 7.42)	10.87 (2.82 to 18.94)
Junge & Dvorak (2007) U-19 World Championship 2002							
Junge & Dvorak (2007) U-19 World Championship 2004							
Junge & Dvorak (2007) U-20 World Championship 2006							
Waldén (2007) European Championship 2005							

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using an **all physical complaints definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 9. Women's international football injury surveillance studies: overall injury incidence rates (per 1,000 hours of exposure) stratified by severity of injury.

	Slight (<1 day)	Minimal (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)
Hägglund et al (2009) U-19 European Championship 2006	2.34 (0.05 to 4.64)	7.62 (3.48 to 11.76)	1.17 (-0.45 to 2.80)	1.17 (-0.45 to 2.80)	1.17 (-0.45 to 2.80)
Hägglund et al (2009) U-19 European Championship 2007	0.00	4.98 (1.29 to 8.66)	0.71 (-0.68 to 2.10)	2.13 (-0.27 to 4.55)	0.71 (-0.68 to 2.10)
Hägglund et al (2009) U-19 European Championship 2008	0.00	3.06 (0.38 to 5.74)	0.00	1.22 (0.47 to 2.92)	0.61 (-0.59 to 1.81)
Junge et al (2004) World Cup 1999					
Junge & Dvorak (2007) World Cup 2003					
Junge et al (2004) Olympic Games 2000					
Junge et al (2006) Olympic Games 2004					
Junge & Dvorak (2007) U-19 World Championship 2002					
Junge & Dvorak (2007) U-19 World Championship 2004					
Junge & Dvorak (2007) U-20 World Championship 2006					
Waldén (2007) European Championship 2005	1.65 (-0.22 to 3.51)	4.39 (1.35 to 7.44)	0.00	2.20 (-2.11 to 6.50)	1.65 (-0.22 to 3.51)

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using a **time-loss definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Table 10. Women's international football injury surveillance studies: match injury incidence rates (per 1,000 hours of exposure) stratified by severity of injury.

	Slight (<1 day)	Minimal (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)
Hägglund et al (2009) U-19 European Championship 2006					
Hägglund et al (2009) U-19 European Championship 2007					
Hägglund et al (2009) U-19 European Championship 2008					
Junge et al (2004) World Cup 1999					
Junge & Dvorak (2007) World Cup 2003					
Junge et al (2004) Olympic Games 2000	34.34 (18.02 to 50.67)	12.12 (2.42 to 21.82)	4.04 (-1.56 to 9.64)	8.08 (0.16 to 16.00)	0.00
Junge et al (2006) Olympic Games 2004	32.63 (18.68 to 46.59)	15.54 (5.91 to 25.18)	7.77 (0.96 to 14.58)	4.66 (-0.61 to 9.94)	1.55 (-1.49 to 4.60)
Junge & Dvorak (2007) U-19 World Championship 2002					
Junge & Dvorak (2007) U-19 World Championship 2004					
Junge & Dvorak (2007) U-20 World Championship 2006					
Waldén (2007) European Championship 2005					

Values are IIR (95% CI).
Footnote: these data relate to the quantification of injury incidence rates using an **all physical complaints definition of injury**; blank cells indicate that these data were not reported or were not calculable (based upon reported data in the article).

Supplementary File 6.

Table 1. Women's elite football: overall, match, & training injury incidence rates (per 1,000 hour of exposure) stratified by severity of injury.

Description					Poisson regression meta-analysis						
Level	**Setting**	**Injury Definition**	**Severity**	**Days**	**Model**	**k**	**Summary Incidence Rate**	**95% CI**	χ^2_{Wald}	T^2	I^2
Elite	Overall	Time-loss	Slight	<1	Fixed	2	0.02	0.003 to 0.15	0.01 (p=0.99)	NA	NA
Elite	Overall	Time-loss	Minimal	1-3	Random	4	1.21	0.91 to 1.62	13.06 (p<0.01)	0.06	71.40%
Elite	Overall	Time-loss	Mild	4-7	Random	4	1.26	1.04 to 1.54	7.01 (p=0.07)	0.02	45.13%
Elite	Overall	Time-loss	Moderate	8-28	Random	4	1.64	1.40 to 1.92	5.25 (p=0.15)	0.01	30.24%
Elite	Overall	Time-loss	Severe	>28	Random	4	0.74	0.56 to 0.97	7.53 (p=0.06)	0.04	48.52%
Elite	Match	Time-loss	Slight	<1	Fixed	2	NA*	NA*	NA	NA	NA
Elite	Match	Time-loss	Minimal	1-3	Fixed	2	4.51	3.22 to 6.31	0.35 (p=0.55)	NA	NA
Elite	Match	Time-loss	Mild	4-7	Fixed	2	3.45	2.35 to 5.06	0.97 (p=0.33)	NA	NA
Elite	Match	Time-loss	Moderate	8-28	Fixed	2	3.85	2.67 to 5.54	1.02 (p=0.31)	NA	NA
Elite	Match	Time-loss	Severe	>28	Fixed	2	2.12	1.30 to 3.46	1.64 (p=0.20)	NA	NA
Elite	Training	Time-loss	Slight	<1	Fixed	2	0.02	0.003 to 0.17	0.01 (p=0.99)	NA	NA
Elite	Training	Time-loss	Minimal	1-3	Fixed	2	0.81	0.57 to 1.14	0.05 (p=0.82)	NA	NA
Elite	Training	Time-loss	Mild	4-7	Fixed	2	0.88	0.64 to 1.22	0.01 (p=0.99)	NA	NA
Elite	Training	Time-loss	Moderate	8-28	Fixed	2	0.88	0.64 to 1.22	0.20 (p=0.66)	NA	NA
Elite	Training	Time-loss	Severe	>28	Fixed	2	0.32	0.19 to 0.55	0.01 (p=0.99)	NA	NA

*Zero events reported in studies included in this meta-analysis, thus yielding no summary effect estimate.

Table 2. Women's international football: overall injury incidence rates (per 1,000 hour of exposure) stratified by severity of injury.

Description					Poisson regression meta-analysis				
Level	**Setting**	**Injury Definition**	**Severity**	**Days**	**Model**	**k**	**Summary Incidence Rate**	**95% CI**	χ^2_{Wald}
International	Overall	Time-loss	Slight	<1	Fixed	4	NA*	NA	NA
International	Overall	Time-loss	Minimal	1-3	Fixed	4	5.02	3.57 to 7.07	3.53 (p=0.32)
International	Overall	Time-loss	Mild	4-7	Fixed	4	NA*	NA	NA
International	Overall	Time-loss	Moderate	8-28	Fixed	4	1.67	0.93 to 3.02	0.91 (p=0.83)
International	Overall	Time-loss	Severe	>28	Fixed	4	1.07	0.51 to 2.23	1.02 (p=0.80)

*Zero events and zero exposure hours reported by ≥1 study included in these meta-analyses, thus yielding no summary effect estimate.

Table 3. Women's international football: match injury incidence rates (per 1,000 hour of exposure) stratified by severity of injury.

Description					Poisson regression meta-analysis				
Level	**Setting**	**Injury Definition**	**Severity**	**Days**	**Model**	**k**	**Summary Incidence Rate**	**95% CI**	χ^2_{Wald}
International	Match	All physical complaints	Slight	<1	Fixed	2	33.38	24.29 to 45.87	0.02 (p=0.88)
International	Match	All physical complaints	Minimal	1-3	Fixed	2	14.05	8.61 to 22.94	0.23 (p=0.63)
International	Match	All physical complaints	Mild	4-7	Fixed	2	6.15	2.93 to 12.90	0.61 (p=0.43)
International	Match	All physical complaints	Moderate	8-28	Fixed	2	6.15	2.93 to 12.90	0.52 (p=0.47)
International	Match	All physical complaints	Severe	>28	Fixed	2	0.88	0.12 to 6.24	0.01 (p=0.99)

Supplementary File 7. Injury definitions used across included studies.

Table 1. Women's amateur football studies

	Injury definition (from article)	Authors' interpretation/classification of injury definition	Data reported in article		
			Time-loss	All Physical Complaints	Hybrid[a]
McNoe & Chalmers (2010)	"an event occurring during a soccer match or training session that required medical attention (including self-treatment) or caused the player to miss at least one scheduled match or team training session"	Hybrid[a]	✖	✖	✓
Jacobson & Tegner (2006)	"damage to the body sustained during practice or game session causing absence from at least the following practice and/or game session"	Time-loss	✓	✖	✖

[a] Does not satisfy the criteria for classification as **all physical complaints** or **time-loss**

Table 2. Women's elite football studies

	Injury definition (from article)	Our classification of injury definition	Data reported in article		
			Time-loss	All Physical Complaints	Hybrid
Ibikunle et al (2019)	"any event occurring during a scheduled training session or a match, resulting in the player leaving that session/match or missing a subsequent session/match"	Time-loss	✓	✘	✘
Babwah (2014)	No definition provided	Time-loss (article page 330)	✓	✓	✘
Nilstad et al (2014)	"an injury was recorded if it resulted in a player being unable to take a full part in future football training or match play at least 1 day beyond the occurrence of the injury"	Time-loss	✓	✘	✘
Giza et al (2012)	"those conditions which were reported to and evaluated by the team physician or athletic trainer"	All physical complaints	✘	✓	✘
Ekstrand et al (2011)	"injury resulting from playing football and leading to a player being unable to fully participate in future training or match play (i.e., time loss injury)"	Time-loss	✓	✘	✘
Gaulrapp et al (2010)	"an injury was defined as a specific and 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"	Time-loss	✓	✘	✘
Hägglund et al (2009)	"a physical complaint resulting from football training or match	Time-loss	✓	✘	✘

	play leading to the player being unable to participate fully in at least one training session or match"				
Tegnander et al (2008)	"the team physiotherapists recorded all injuries that caused the player to be unable to fully take part in the next match or training session (''time loss'' injury)"	Time-loss	✓	✘	✘
Jacobson & Tegner (2007)	"as damage to the body sustained during practice or game session causing absence from at least the following practice and/or game session"	Time-loss	✓	✘	✘
Faude et al (2005)	"any physical complaint associated with soccer (received during training or a match) that limits athletic participation for at least the day after the day of the onset"	Time-loss	✓	✘	✘

Table 3. Women's international football studies

	Injury definition (from article)	Authors' interpretation/classification of injury definition	Data reported in article		
			Time-loss	All Physical Complaints	Hybrid[a]
Hägglund et al (2009) U-19 European Championship 2006	"injury resulting from playing football and leading to a player being unable to fully participate in future training or match play (i.e., time loss injury).	Time-loss	✓	✘	✘
Hägglund et al (2009) U-19 European Championship 2007	"injury resulting from playing football and leading to a player being unable to fully participate in future training or match play (i.e., time loss injury).	Time-loss	✓	✘	✘
Hägglund et al (2009) U-19 European Championship 2008	"injury resulting from playing football and leading to a player being unable to fully participate in future training or match play (i.e., time loss injury).	Time-loss	✓	✘	✘
Junge et al (2004) World Cup 1999	"an injury was defined as any physical complaint arising during the match regardless of the consequences with respect to subsequent absence from matches or training"	All physical complaints	✘	✓	✘

Junge & Dvorak (2007) World Cup 2003	"an injury was defined as any physical complaint during a match which received medical attention from the team doctor, regardless of the consequences with respect to absence from the rest of the match or training"	All physical complaints	✘	✓	✘
Junge et al (2004) Olympic Games 2000	"an injury was defined as any physical complaint arising during the match regardless of the consequences with respect to subsequent absence from matches or training"	All physical complaints	✘	✓	✘
Junge et al (2006) Olympic Games 2004	"an injury was defined as any physical complaint incurred during the match that received medical attention from the team physician, regardless of the consequences with respect to absence from the match or training"	All physical complaints	✘	✓	✘
Junge & Dvorak (2007) U-19 World Championship 2002	"an injury was defined as any physical complaint during a match which received medical attention from the team doctor, regardless of the consequences with respect to absence from	All physical complaints	✘	✓	✘

	the rest of the match or training"				
Junge & Dvorak (2007) U-19 World Championship 2004	"an injury was defined as any physical complaint during a match which received medical attention from the team doctor, regardless of the consequences with respect to absence from the rest of the match or training"	All physical complaints	✘	✓	✘
Junge & Dvorak (2007) U-20 World Championship 2006	"an injury was defined as any physical complaint during a match which received medical attention from the team doctor, regardless of the consequences with respect to absence from the rest of the match or training"	All physical complaints	✘	✓	✘
Waldén et al (2007) European Championship 2005	"time loss injury was defined as an incident occurring during scheduled training sessions or matches causing the player to miss the next training session or match"	Time-loss	✓	✘	✘

Supplementary File 8. Injury reporting mechanisms used across included studies.

Table 1. Women's amateur football studies

	Injury reporting mechanisms (from article)
McNoe & Chalmers (2010)	"Throughout the winter competitive season (April to September), players were contacted each week and a ''weekly'' questionnaire administered. The necessity to call back players because of unavailability was minimized by prearranging call times; no systematic record was kept of the number of call-backs made. If contact was not made in a given week, no attempt was made to collect the data retrospectively" The players were asked to recall information for the week leading up to and including the most recent Sunday before data collection. Prompts were provided on the response categories for each question. The players were asked to report the number and duration of training sessions and matches in which they participated, injuries sustained, the circumstances of injury, and behavior in relation to injury prevention measures promoted by NZS" **SUMMARY: Player self-report**
Jacobson & Tegner (2006)	"Individual participation in club/team scheduled practice and game sessions (presence/time loss) as well as injuries were registered by the respective trainer/coach, using standardized attendance protocols and reported once a week" "The reported injured players were interviewed by telephone shortly after the injury by the first author, a sports medicine specialist, using a standardized protocol that included location of injury, injury mechanism, type of injury, occasion of injury, playing position, dominant foot, ball contact, foul play, re-injury, medical consultation, treatment, etc. No clinical examinations were made" **SUMMARY: Player self-report**

Table 2. Women's elite football studies

	Injury reporting mechanisms (from article)
Ibikunle et al (2019)	"The researcher contacted the various clubs by visiting each of the selected clubs in their camps. During those visits, the researcher educated the medical personnel in various clubs on the purpose of the research, how to make use of the various forms. The researcher also recruited eight physiotherapists to serve as research assistants. The purpose, procedures and ethical components of the research were duly explained to the various participants including the footballers. The researcher and the research assistants frequently visited the clubs, supervised and monitored the filling of these forms regularly. The injury forms were completed on ad hoc basis as and when injuries arose. At the end of every month, the researcher retrieved the forms from various clubs" "The UEFA Injury Report Forms was used for data collection" **SUMMARY: Medical staff registration**
Babwah (2014)	"The teams' trainers, coaches or physiotherapists provided anonymized injury data when contacted via telephone on the Monday after games" **SUMMARY: Trainer, coach AND Medical staff registration**
Nilstad et al (2014)	Individual registration: "All players (n = 228) were carefully informed on the data collection procedure prior to the start of the study. They reported injuries and exposure individually using text messaging (SMS) based on an SMS-tracking system (New Agenda Solutions Aps, Copenhagen, Denmark). The registration was conducted on a weekly basis through the automatic generation of three text messages sent every Sunday evening. One SMS was sent out for each of the three questions and the players replied to each of these: 1. How many minutes of match play did you do last week? Sum up all matches and report the total number of minutes played. 2. How many hours of training did you do last week? Sum up your total hours of football practice, rounding up to nearest full hour. 3. Have you had any injury or illness that has restricted you from full participation in one or more training sessions and/or matches last week? Answer yes or no. The responses were recorded in a system-generated database. If the players forgot to reply to one or more of the text messages, they automatically received a first reminder after 2 days and a second reminder after another 2 days. If an injury or illness was reported, the player was contacted by telephone to complete the injury form and collect information regarding the injury circumstances. The injured player was followed-up until she answered "no" on the injury question and was subsequently contacted to establish the correct number of days of absence. Injuries occurring before the start of the injury registration or those occurring in activities other than football training or match were not included. All telephone interviews were conducted by the principal investigator (AN) and the interviews were done within 1–4 days after an injury was reported" Medical staff registration: "Concurrent with the individual SMS registration, a member of the medical staff from all 12 teams reported injuries and exposure on the team level. Prior to the start of the study, they received detailed information and a manual on how to record injuries and exposure. The team physiotherapist performed the prospective injury registration and also recorded team training and match

	exposure in cooperation with the coach. Injuries were reported using the same injury form as for the individual registration. Exposure data were reported on a monthly basis using a separate form. This exposure form was designed as a calendar, collecting information on type of activity (training or match), playing surface (natural grass, artificial turf, or other), the duration of each session (number of minutes), and the number of players attending each session. The medical staff submitted their exposure and injury forms every month. If necessary, they were reminded by telephone or e-mail by the principal investigator. If information was missing or unclear, we contacted the medical staff members to complete the registration" **SUMMARY: Player-self report AND Medical staff registration**
Giza et al (2012)	"Injuries in this study were defined as those conditions which were reported to and evaluated by the team physician or athletic trainer. Each injury was subsequently reported to the league insurance company via a standardised 'first report of injury' form which is completed by the team trainer. All injury reports were verified by an examination by the team physician. **SUMMARY: Medical staff registration**
Ekstrand et al (2011)	"Report forms were sent to the study group on a monthly basis, and clubs were provided with regular feedback to improve accuracy and consistency in reporting. Player exposure and surface type were registered for all training sessions and matches (including matches with national teams and reserve teams) on a standard exposure form (Hägglund et al., 2005) by a member of the squad, who was present at all training sessions and matches. The team medical staff recorded all injuries on a standard injury form (Hägglund et al., 2005) immediately after the event" **SUMMARY: Medical staff registration**
Gaulrapp et al (2010)	"Along with the name of the player, team physicians recorded the mechanism, region, and type of the injury. They also noted whether the injury occurred during a game (minute of play) and the month of practice within the season" **SUMMARY: Medical staff registration**
Hägglund et al (2009)	"A club representative recorded individual playing time in training and friendly and competitive matches on a standard exposure form. This included first and second team, as well as national team exposure for all players, and was returned on a monthly basis" "The club medical staff documented all time loss injuries that occurred during the study period on a standard injury form" **SUMMARY: Medical staff registration**
Tegnander et al (2008)	"The team coaches recorded the type and duration of all training sessions and the number of players participating" "In accordance with the consensus statement on injury definitions and data collection procedures, the team physiotherapists recorded all injuries that caused the player to be unable to fully take part in the next match or training session (''time loss'' injury)" **SUMMARY: Medical staff registration**

Jacobson & Tegner (2007)	"Participation in club/team-scheduled practice and game sessions as well as injuries were registered by the respective trainer/coach, using standardized attendance protocols (Ekstrand, 1982). Individual participation and injuries in the national women's and U-21 teams were registered by the physiotherapist for each team. The attendance protocol was reported once a week from the club teams, or after every national gathering, to the first author" "The reported injured players were interviewed by telephone by the first author using a standardized protocol that included location of injury, injury mechanism, type of injury, occasion of injury, playing position, dominant foot, ball contact, foul play, re-injury, medical consultation, treatment, etc. (Ekstrand, 1982)" **SUMMARY: Player-self report**
Faude et al (2005)	"During the season, the team coach recorded the amount of time spent in training and matches, as well as the reason for and duration of any absences for each individual player, on a weekly basis. The team physical therapists reported all injuries with regard to their type, location, and circumstances of occurrence. All information was documented on specially designed forms" **SUMMARY: Medical staff registration**

Table 3. Women's international football studies

	Injury reporting mechanisms (from article)
Hägglund et al (2009) U-19 European Championship 2006	"The team physician documented individual player training exposure and time loss injuries that occurred during the tournament on standard forms" **SUMMARY: Medical staff registration**
Hägglund et al (2009) U-19 European Championship 2007	"The team physician documented individual player training exposure and time loss injuries that occurred during the tournament on standard forms" **SUMMARY: Medical staff registration**
Hägglund et al (2009) U-19 European Championship 2008	"The team physician documented individual player training exposure and time loss injuries that occurred during the tournament on standard forms" **SUMMARY: Medical staff registration**
Junge et al (2004) World Cup 1999	"The physicians of all participating teams were asked to report all injuries after each match on a specially designed injury report form" **SUMMARY: Medical staff registration**
Junge & Dvorak (2007) World Cup 2003	"At a pre-tournament instructional meeting, doctors of all attending teams were asked to report the details of every injury that occurred during a match in an injury report form" **SUMMARY: Medical staff registration**
Junge et al (2004) Olympic Games 2000	"The physicians of all participating teams were asked to report all injuries after each match on a specially designed injury report form" **SUMMARY: Medical staff registration**
Junge et al (2006) Olympic Games 2004	"For each match, the physicians of both teams were instructed to return the completed form of their team to the medical representative of their IF" **SUMMARY: Medical staff registration**
Junge & Dvorak (2007) U-19 World Championship 2002	"At a pre-tournament instructional meeting, doctors of all attending teams were asked to report the details of every injury that occurred during a match in an injury report form" **SUMMARY: Medical staff registration**
Junge & Dvorak (2007)	"At a pre-tournament instructional meeting, doctors of all attending teams were asked to report the details of every injury that occurred during a match in an injury report form"

U-19 World Championship 2004	**SUMMARY: Medical staff registration**
Junge & Dvorak (2007) U-20 World Championship 2006	"At a pre-tournament instructional meeting, doctors of all attending teams were asked to report the details of every injury that occurred during a match in an injury report form" **SUMMARY: Medical staff registration**
Waldén et al (2007) European Championship 2005	"The national team physician documented each injury immediately after the event on a standard injury card. The injury card provided information on the date of injury, activity (training or match), injury type, injury location, injured side, injury circumstance and injury mechanism" **SUMMARY: Medical staff registration**

Supplementary File 10.

We did not include the following studies in our systematic review and meta-analysis:

1. Becker et al (2006): this article was not available in the English language, and we did not have the availability of a translator.
2. Ellias (2001): this study did not comply with our specific eligibility criteria of: participation in a senior women's football league (amateur or elite) for a minimum duration of one season; (2) participation in a senior women's international football tournament
3. Engström et al (1991): this study only presented data on one elite-level team and hence did not comply with our eligibility criteria (i.e., case reports on single teams were ineligible)
4. FIFA (2015): this was a technical report and did not comply with our specific eligibility criteria of: the study had to: (1) be a full text article published in a peer-reviewed journal before July 2021; (2) be a prospective injury surveillance study.
5. Fuller (2007a, 2007b): the data in this study comes from US varsity football/soccer
6. Junge et al (2013) – 3 sets of data: this study presents aggregated data for 4 FIFA World Cups, 4 Olympic games, and 4 U19/U20 World Cups. We have taken the approach of including individual-level study data, instead of using data that has already been aggregated. When performing a meta-analysis, we believe that a more robust approach is to use individual-level study data, instead of already aggregated data; especially considering that the methods of data aggregation were not specified in Junge et al (2013).
7. Larruskain et al (2018): this study only presented data on one elite-level team and hence did not comply with our eligibility criteria (i.e., case reports on single teams were ineligible)
8. Maehlum & Daljord (1984): the data from this study comes from injuries treated in an Emergency Department did not comply with our specific eligibility criteria of: the study had to: (1) be a full text article published in a peer-reviewed journal before July 2021; (2) be a prospective injury surveillance study.
9. Östenberg & Roos (2000): from the data presented in this article, it was not possible to differentiate IIRs between amateur-level and elite-level players.
10. Owoeye et al (2012): the data presented in this study is from a national tournament and did not comply with our specific eligibility criteria of: participation in a senior women's football league (amateur or elite) for a minimum duration of one season or participation in a senior women's international football tournament.