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Title: The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies.

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Key Words:

Ankle Sprain, Inclusion Criteria, Incidence Rate, Prevalence Period

ABSTRACT

Context: ankle sprain is one of the most common musculoskeletal injuries, yet a contemporary review and meta-analysis of prospective epidemiological studies investigating ankle sprain does not exist.

Objective: to provide an up-to-date account of the incidence rate and prevalence period of ankle sprain injury unlimited by timeframe or context activity.

Data Sources: systematic review and meta-analyses of English articles using relevant computerised databases. Search terms included Medical Search Headings for the ankle joint, injury and epidemiology.

Study selection: the following inclusion criteria were used: the study must report epidemiology findings of injuries sustained in an observed sample; the study must report ankle sprain injury with either incidence rate or prevalence period among the surveyed sample, or provide sufficient data from which these figures could be calculated; the study design must be prospective.

Data extraction: independent extraction of articles was performed by two authors using pre-determined data fields.

Data synthesis: 181 prospective epidemiology studies from 149 separate papers were included. The average rating of all the included studies was 6.67/11. 116 studies were considered high quality and 65 were considered low quality. The main findings of the meta-analysis demonstrated a higher incidence of ankle sprain in females compared to males (13.6 versus 6.94 per 1000 exposures), in children compared to adolescents (2.85 versus 1.94 per 1000 exposures) and adolescents compared to adults (1.94 versus 0.72 per 1000 exposures). The sport category with the highest incidence of ankle sprain was indoor/court sports, with a cumulative incidence rate of 7 per 1000 exposures or 1.37 per 1000 athlete exposures and 4.9 per 1000 hours. Low quality studies tended to underestimate the incidence of ankle sprain when compared to high quality studies (0.54 versus .12 per 1000 exposures). Ankle sprain prevalence period estimates were similar across sub-groups. Lateral ankle sprain was the most commonly observed type of ankle sprain.

Conclusions: females were at a higher risk of sustaining an ankle sprain compared to males, children compared to adolescents and adults, with indoor and court sports the highest risk activity. Studies at a greater risk of bias were more likely to underestimate the risk of ankle sprain. Participants were at a significantly higher risk of sustaining a lateral ankle sprain compared with syndesmotic and medial ankle sprains.

1. Introduction:

Ankle sprain accounts for between 3% and 5% of all Emergency Department visits in the UK, equating to approximately 5,600 incidences per day (1). Despite the high prevalence and severity of lifestyle-limiting symptoms that follow the acute episode (2) (3), ankle sprains are oftentimes regarded as benign injuries that will resolve quickly with limited treatment (4, 5).

Ankle sprain in sport may result in varying degrees of debilitation, including decreased performance, absence from competition and adverse psychological effects (6). Following an acute ankle sprain, pain, swelling and ecchymosis are common, which may contribute to reduced mobility and function, as well as occupational absence. The incidence of residual symptoms following acute ankle sprain is variable, but has been reported with rates of between 40% and 50% (7-10). The vast extent of these residual symptoms have prompted the creation of several homogenous subsets (mechanical insufficiencies which include arthrokinematic restrictions, laxity, synovial changes and degeneration, and functional insufficiencies, which include impaired proprioception, postural control, neuromuscular control and strength deficits) of a heterogenous condition referred to as chronic ankle instability (CAI) (11). CAI has been defined as an encompassing term used to classify a subject with both mechanical and functional instability of the ankle joint. To be classified as having CAI, residual symptoms ("giving way" and feelings of ankle joint instability) should be present for a minimum of one year post initial sprain (12).

Ankle sprain has high societal economic costs associated with the diagnosis, treatment, and loss of work productivity contingent with the severity of injury. It has been reported that one quarter of all people who sustain an ankle sprain are unable to attend school or work for more than seven days following the initial injury (13). The economic burden of ankle sprain cannot be disputed, as the mean total cost of one ankle sprain in the Netherlands has been reported to be approximately €360 (14) equating to an estimated annual cost of €84,240,000 in the Netherlands alone.

Musculoskeletal injury is also a persistent and primary health concern for military populations as it is a leading cause of hospitalisation and accounts for a significant amount of lost duty time (15). The yearly cost of military musculoskeletal injuries has been estimated to equate to nearly €1 billion (US dollars), with ankle sprain the 7th most prevalent injury subgroup (16). Military musculoskeletal injuries results in both short term and long term disability, and places a substantial burden on the medical system (17). Ankle sprains are one of the most common musculoskeletal injuries and present a significant issue for military healthcare practitioners (18-22)

The consequences of the developed insufficiencies following an acute ankle sprain extend beyond the context of active populations (23). It has recently been acknowledged that CAI is a leading cause of post-traumatic ankle joint osteoarthritis (24-26). Furthermore, it has previously been demonstrated that chronic peripheral joint injury such as CAI negatively alters central mechanisms of motor control, leading to an increased risk of falls (27, 28). Therefore, investigating the incidence of ankle sprain and including data relating to various populations is of clinical relevance.

The first step of the United States' public health model of injury prevention and control (17) involves identifying the scope and magnitude of musculoskeletal injuries through injury surveillance. It is only by adopting this paradigm that methodological and intervention specificity can be achieved to meet the demands of distinct groups with the aim of injury prevention and control. (17). A systematic review by Fong et al. indicated that the ankle joint is the second most commonly injured joint in those who participate in sport related activities (29). Since the completion of this review, a number of epidemiological surveillance papers investigating ankle sprain injury in a variety of samples have been published.

Therefore, identifying the scope and magnitude of ankle sprain injury stands to be updated and advanced via the use of appropriate statistical techniques in meta-analysis of eligible studies. The aim of this systematic review and meta-analysis is to examine ankle sprain prevalence period and incidence rate unrestricted by sample activity context. This analysis will be limited to prospective studies only. Our main objectives are to determine if ankle sprain incidence rate and prevalence period is affected by age, gender and the nature of sporting activity. We will also consider whether incidence and prevalence figures are influenced by study quality. Such an analysis will meet the first criterion required to tackle issues of injury prevention and control. Surveillance of ankle sprain in a number of population types stands to elucidate the contrasting patterns of ankle sprain injury in a variety of settings.

2. Methodology

The study protocol was developed using the framework outlined in the guidelines provided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyes) statement. (30)

2.1 Literature Search Strategy

In July 2012, we undertook a computerized literature search of the following databases from inception: Web of Science, CINAHL, Cochrane Central Register of Controlled Trials, PEDro, Embase, Pubmed and SportDiscus. The database search was further supplemented with a single related-citation search on PubMed (National Centre for Biotechnology Information, U.S. National Library of Medicine. Home page. http://www.ncbi.nlm.nih.gov/pubmed. Accessed July 2012)-this retrieved a set of articles closely related to ankle sprain injuries. The search strategy was designed with the purpose of extracting epidemiological studies of ankle sprain injury in multiple population groups. Recurrent sprain and chronic ankle instability are pathologies frequently described in the aforementioned investigations. This was accounted for in the formulation of the following search strategy:

Population-specific and patient-specific search terms were combined using Boolean operators as follows: (1) ankle OR “ankle joint”, (2) injury OR injuries OR strain OR strains OR sprain OR sprains OR rupture OR ruptures OR repeated OR multiple OR recurrent OR instability OR "recurrent instability" OR "chronic instability" OR “functional instability” OR “mechanical instability”, (3) "ankle instability" OR "chronic ankle sprain” (4) epidemiology OR epidemiologic OR epidemiological OR survey OR statistics OR pattern OR patterns OR incidence OR incidences OR prevalence OR prevalences (5) (1 AND [2 OR 3] AND 4).

The search strategy was limited to full text studies published in the English language. Published abstracts were followed up for full-text publication, but were not included as independent papers.

One investigator (CD) reviewed all the titles produced by the database searches, and retrieved suitable abstracts. Implied suitability via abstract review dictated the retrieval of full texts. These were included in the review if they fulfilled the required selection criteria.

2.2 Selection Criteria

No blinding of study author, place of publication, or results occurred. The following inclusion criteria were used:

(1) The study must report epidemiology findings of injuries sustained in an observed sample.
(2) The study must report ankle sprain injury with either incidence rate or prevalence period among the surveyed sample, or provide sufficient data from which these figures could be calculated.
(3) The study design must be prospective.
No restrictions were placed on the participant age, gender or activity level. Review articles and individual case studies were excluded. Abstracts from conferences were not reviewed for inclusion because of their limited availability in the electronic databases.

2.3 Assessment of Study Quality

Two authors (C.D & C.B) evaluated study quality, which gives an indication of risk of bias. Study quality was assessed using an adapted version of the STROBE guidelines for rating observational studies (31)-all included studies were rated on 11 specific criteria which were derived from items 5, 6, 7, 8, 9, 12, 14 and 15 of the original checklist (figure 1).
The observational studies were considered as having a low risk of bias if they were determined as high quality (score of ≥7/11) or a high risk of bias if they were low quality (≤6/11). Final study ratings for each reviewer were collated and examined for discrepancies. Any inter-rater disagreement was resolved by consensus decision. Once consensus was reached for all study ratings, overall quality scores were collated by summing those criteria, providing a score out of 11.

2.4 Data Management and Statistical Analysis

Three authors (C.D, C.B & E.D) extracted key data onto an Excel spread-sheet template. Studies were classified by injury focus (whether injuries of all types or ankle injuries in isolation were reported), sample demographics (region, age-group, period of completion, sample size, gender, context activity), method of diagnosis (independent trained healthcare worker, author or subject report) and duration (number of seasons). Data relating to prevalence period and incidence rate were recorded for the subgroups of gender (male; female), age (child; adolescent; adult), quality (high; low) and activity (field sports; ice & water sports; court sports; outdoor sports)

Prevalence period represents the ratio of the number of events (ankle sprains) existing in a population over a specified time to the study population in that time. Incidence rate is the ratio of the number of events commencing during a specified time to the average population during the same period of time.

$$Prevalence\ period = \frac{Sum\ of\ ankle\ sprains\ existing\ over\ a\ specified\ time}{Population\ at\ that\ time}$$

$$Incidence\ per\ 1000\ units\ of\ exposure = \frac{Sum\ of\ ankle\ sprains\ commencing\ over\ a\ specfified\ time}{Sum\ of\ exposure\ units\ for\ all\ included\ samples}\ x1000$$

Articles reporting incidence were divided according to the unit of exposure used (e.g. per thousand athlete exposures or per thousand hours). In situations where data was presented in other forms (e.g. per 10000 units of exposure), efforts were made to synthesize data by converting them to a common unit of exposure when possible. Cumulative incidence rate figures combined the units of athlete exposure and hours of exposure to provide a resultant value. In the presence of any unclear or missing data, authors were contacted by email for clarification.

2.4.1 Meta-Analysis

For each study, standard error and variance were calculated for prevalence period and incidence rate estimates. Individual study estimates were then pooled based on the following subgroups: gender, sport category, study quality and age.

The gender subgroup was classified as male or female based on a surveyed sample of 60-100% male or female subjects respectively. Age was classified by three broad categories: children (aged: 0 to ≤12 years); adolescent (aged: ≥13 to ≤17 years); adult (aged: ≥18 years). Study quality was classified into two categories: high quality (≥7/11) or low quality (≤6/11). Sport was categorised by field, indoor/court, ice/water and outdoor sports (table 1).

Studies were weighted by sample size and separate analyses were undertaken for prevalence period and incidence rate data. Data were then assessed for heterogeneity using Microsoft Excel 2010 (32), based on the Q test in conjunction with the I^2 statistic. The significance for Chi^2 was set at $P < 0.1$. The I^2 statistic was used to quantify inconsistency using the following formula $I^2 = [(Qdf)/Q] \times 100\%$, where Q is the Chi^2 statistic and df its degrees of freedom. I^2 values greater than 50% were considered to represent substantial heterogeneity (33). In cases were substantial heterogeneity were present, a random effects model was used for meta-analysis. Accordingly, prevalence and incidence were used to enable several forest plots. A 95% CI was used in the analysis. The horizontal bars in the plots represent the range of confidence interval (CI), and also give an indication of the study weight (smaller width=larger weight).

3. Results.

3.1 Search Strategy

The search strategy returned a total of 10524 articles for review. Articles were included based on a group consensus. Refer to figure 2 for information pertaining to the total number of studies screened, assessed for eligibility and included in the analysis (with reasons for exclusions at each stage). A total of 181 prospective epidemiology studies from 149 separate papers were included in the systematic review and meta-analyses (20, 34-179).

3.2 Methodological Quality

The average rating of all the included studies was 6.67/11 (6.94 for all the male studies, 7.41 for all the female studies and 5.81 for all the studies with mixed gender samples; 6.57 for all studies with only child samples, 7.56 for adolescent-only samples and 6.64 for adult-only samples). 116 studies were considered high quality (≥7/11), having a low risk of bias, and 65 were considered low quality (≤6/11), having a high risk of bias. Consensus was reached for all items on initial discussion. No studies were excluded from analysis based on the rating of methodological quality.

3.3 Characteristics of the Included Studies

Some studies consisted of entirely male (75) and female (44) samples, while a number of studies included mixed samples (36). 26 studies included mixed samples but did not report the distribution of males and females.

122 off the 181 studies had adult-only samples, 25 had adolescent-only samples and 11 children-only. A number of studies had mixed samples-adults, adolescents and children combined (10), adults and adolescents only (3) or children and adolescents only (4). 6 studies were unclear of their sample age demographics.

94 of the included studies reported injury as a function of exposure. 87 studies reported ankle sprain as a % of all injuries. Of the 94 studies that did report exposure, 42 reported ankle sprain per 1000 athlete exposures, 44 per 1000 hours, 5 per 1000 days, and 1 each per 1000 jumps, player games and person years. All except 16 of these 94 studies also reported ankle sprain period prevalence.

Similarly, the nature of injury diagnosis differed substantially between studies. 153 studies used the diagnosis of an independent medical professional, 4 used that of the authors themselves, 4 used coaches, 11 used the subjects' own report and 7 used a mix of all.

173 studies reported on sporting populations and the remaining 8 included military populations.

Twenty one (12%) papers included a surveyed sample of 0-100 participants, seventy five (41%) had 100-200 participants, nineteen (10%) had 500-1000 participants, seventeen (9%) had 1000-2000 participants, fourteen (8%) had 2000-5000 participants, twenty-five (14%) had 5000-10000 participants and 10 (6%) had over 10000 participants. A group of authors responsible for 13 of the included studies was contacted to provide clarification of their surveyed sample sizes.

The total number of sports analysed was 37. Sports were sub-classified into 4 categories (Table 1).

Five papers reported re-sprains within the surveyed sample. Three of these five were surveying ankle sprain injuries in isolation (56, 63, 180) and two reported ankle sprains among all injuries (97, 181). For the purposes of prevalence period and incidence rate estimates, the total number of sprains/re-sprains were used in the prevalence period and incidence rate calculations.

3.4 Findings-Meta Analyses

Figures 3-9 and table 2 present pooled estimates (95% CI's) for each sub-group. There was a high degree of heterogeneity across studies within each of the subgroups ($p<0.01$), (Table 2) and random effects models were used in all cases.

Indoor and court sports were the highest risk activity, based on cumulative incidence and prevalence figures, whereas outdoor sports presented the lowest risk activity subgroup. Females were more likely to sustain an ankle sprain than males, and children more likely than adolescents and adults.

3.4.1 Sport

Pooled cumulative incidence was 7 ankle sprains per 1000 exposures (CI: 6.8 to 7.1) for court sports, 3.7 per 1000 exposures (CI: 3.3 to 4.17) for ice/water sports, 1.0 per 1000 exposures (CI: 0.9 to 1.05) for field sports and 0.88 per 1000 exposures (CI: 0.73 to 1.02) for outdoor sports -see figure 6. There was a high degree of heterogeneity in all subgroups (Table 2). We found similar findings when incidence data was reported based exposures per 1000 hours and per 1000A/E (Table 2).

Pooled Prevalence of ankle sprain for indoor/court sports was 12.17% (CI: 12.01 to 12.33), 4.36% for water/ice sports (CI: 3.92 to 4.79), 11.3% for field based sports (CI: 11.15 to 11.44) and 11.65% for outdoor pursuits sports (CI: 11.33 to 11.97).

3.4.2 Study Quality

High quality (≥7/11) studies had a pooled cumulative incidence rate of 11.55 per 1000 exposures (CI: +/-0.18) and a pooled prevalence period of 11.88% [CI: 10.56 to 13.19]. Pooled incidence rate figures were reduced in low quality (≤6/11) studies with 0.54 ankle sprains per 1000 exposures (CI: 0.49 to 0.59 and a pooled prevalence of 11.18% [CI: 6.59 to 15.78]). See figure 5.

3.4.3 Gender

Meta-analysis for gender revealed a cumulative incidence rate of 13.6 per 1000 exposures (CI: 13.25 to 13.94) for females and 6.94 per 1000 exposures (CI: 6.8 to 7.09) for males. Incidence figures for gender were also calculated separately per 1000 hours and per 1000 athlete exposures (Table 2). Pooled prevalence of ankle sprains was 10.55% (CI: 10.84 to 11.15) in females and 10.99% (CI: 10.84 to 11.15) for males. See figure 4.

3.4.4 Age

Meta-analysis for age sub-groups revealed a pooled cumulative incidence of 0.72 per 1000 exposures (CI: 0.67 to 0.77) in adults, 1.94 (CI: 1.73 to 2.14) for adolescents and 2.85 (CI: 2.51 to 3.19) for children. 12.62% of all injuries were ankle sprains in children (CI: 11.81 to 13.43), 10.55% in adolescents (CI: 9.92 to 11.17) and 11.41% (CI: 11.28 to 11.54) in adults. See figure 3.

3.4.5 Sprain Diagnosis

11 of the 181 included studies reported specific diagnoses pertaining to the type of ankle sprain incurred by the surveyed sample (Lateral, medial or syndesmotic). 4 of these studies were investigating lateral/inversion sprains in isolation; 1 reported incidence as a percentage of all injuries (and not by specific sprain diagnosis) and therefore could not be considered for this aspect of analysis (Table 3).
Weighted percentage was calculated using the following formula:

$$Weighted\ percentage\left(ankle\,sprain\,type\right)=\frac{\sum_{i=1}^{n} total\ ankle\,sprains\times percentage\left(ankle\,sprain\,type\right)}{\sum_{i=1}^{n} total\ ankle\,sprains}$$

Data collected from the 6 included studies identified a weighted prevalence period of 15.31 for lateral ankle sprains. Lateral ankle sprain was also the most commonly incurred type of ankle sprain based on incidence rate units of athlete exposure, years and hours when compared to medial and syndesmotic ankle sprains (Table 7).

3.4.6 Military Populations

7 studies with entirely military samples were included in the analysis. Each paper surveying military population subgroups employed unique methods of reporting exposure. The risk of ankle sprain was determined per 1000 (parachute) jumps (3.8 lateral ankle sprains per 1000 jumps; 1.08 syndesmotic sprains per 1000 jumps), per 1000 person-years (58.4 per 1000 person years) and as a percentage- 2.8% in one study, and 17.7% in another.

4. Discussion.

The search strategy identified data pertaining to the incidence rate and prevalence period of ankle sprain in a variety of settings from 181 prospective studies in 149 separate research papers. Injury patterns were reported for 37 different sports, and military populations (174 studies were sports related and 7 were military related). Separate meta-analyses were completed for incidence rate and prevalence period data for the subgroups of age, gender, sport and study quality, thus providing evidence for the highest risk activities and populations. Results of these analyses identify the scope and magnitude of ankle sprain injury, thus allowing for methodological and intervention specificity to meet the demands of distinct groups.

Findings from this review revealed a wide variation in ankle sprain incidence estimates, and meta-analyses indicate that females and children were the highest risk population subgroups for sustaining an ankle sprain, with indoor and court sports the highest risk activity. Furthermore, studies with high bias underestimated the risk of ankle sprain. The meta-analysis revealed minimal variation in ankle sprain prevalence related to the sample subgroups. The prevalence of ankle sprain was equal between males and females, between studies of high and low bias, and between age sub-groups. Ice and water sports had the lowest overall prevalence within the sport subcategory.

We devised a rating system for the purpose of determining the methodological quality of the included studies. Assessing the quality of observational epidemiology research has been the focus for a number of research groups (182-186). Hagglund et al. (187), outline key attributes that an epidemiological study should possess, recommending that the design should be prospective, with a clear definition of injury (prospective studies provide a more realistic representation of injury patterns as a result of superior experimental control and data collection techniques), whereby exposure data is collected over the course of at least one entire season (187). Our rating system was a modified version of the STROBE guidelines for rating observational studies (31), and was based on 11 separate variables. We considered this checklist of 11 items essential for good reporting of these observational studies, thus facilitating a feasible means to assess the quality and potential bias of 181 studies.

Meta-analysis of the cumulative incidence rate and prevalence period data by study quality revealed clear differences between high and low quality papers. One hundred sixteen studies were considered high quality and 65 were considered low quality based on this system. Only 2 studies scored full marks on the criteria outlined, with 9 studies scoring 10/11. The pooled estimate of ankle sprain incidence rate in low quality studies (0.54 per 1000 cumulative units of exposure) was 21 times less than that of high quality studies (11.55 per 1000 cumulative units of exposure). Very few of the included studies adhered to the criteria described by Hagglund et al. (187). A potential reason for the tendency of lower quality studies (as measured by our rating system) to underestimate the incidence rate of ankle sprain injury could relate to the absence of a medical professional to appropriately diagnose potential injuries. Indeed, 28 of the included studies did not use an independent medical professional for the diagnosis of injuries in the surveyed sample, with coaches, authors or subjects themselves reporting injury, raising concerns over internal validity secondary to investigator error through reporting bias. Additionally, the lack of a qualified medical professional will corrupt the definition and classification of injury (figure 2; criteria 1 & 3). Considering the high rate of morbidity following an acute ankle sprain (2) (3), the consequences of this methodological inadequacy could theoretically put the injured population at risk of prolonged lifestyle-limiting symptoms secondary to the absence of astute intervention in the acute phase of injury.

Findings of the meta-analysis of cumulative incidence rate and prevalence period by gender elucidated a higher risk of ankle sprain in females compared to males. Of the 94 studies that did report exposure figures for gender, 42 reported ankle sprain per 1000 athlete exposures and 44 reported ankle sprain per 1000 hours, giving a cumulative incidence rate of 13.6 sprains per 1000 exposures for females versus 6.94 per 1000 exposures for males. Gender was the only sub-group whereby sufficient data existed to analyse incidence rate per cumulative exposures, and per hour and athlete exposure separately (table 2). Thirty six of the included studies had mixed gender samples, reporting the exact sample size with specific details of the number of male and female participants. Fifteen of these 36 studies reported injury as a function of exposure (hours or athlete exposures) 6 reported no differences in injury rates between males and females (64) (188) (80) (189) (190) (142), 2 reported a higher risk of injury for men (57) (115) and 2 a higher risk for women (191, 192). Two papers (5 studies) did not report separate injury data for males and females (193) (107) [4 separate studies]. Differences in study design, such as definition of the injury or different data collection methods, may explain these contradictory results.

Women have been reported to sustain more knee joint injuries than men, especially ACL injuries (194). However, to the authors' knowledge, this is the first meta-analysis to determine a higher incidence rate of ankle sprain in females compared to males. Efforts to prevent ankle sprain injury in females should therefore focus on the factors that increase the susceptibility of women to injury and furthermore to develop interventions to facilitate the prevention of these injuries. The anatomical (195-197), hormonal (197-199) and neuromuscular (199, 200) (201) differences that exist between the sexes (202) do not necessarily explain the observed increased risk of ankle sprain in females; this analysis serves to expose possible differences in injury risks between the genders, but can only hypothesize as to their cause. Future research could focus on whether gender differences are activity-specific, and thus related to training behaviours, or whether the difference in risk are related to anatomical or physiological gender differences.

The existence of a higher risk of ankle sprain in children compared to adolescents (2.85 versus 1.94 per 1000 exposures) and adolescents compared to adults (1.94 versus 0.72 per 1000 exposures) as demonstrated by the meta analysis (figure 3) is a significant finding, as injury at a young age can negatively affect a child's ability to participate in activity and may trigger long-term sequelae such as early onset of osteoarthritis (203) (204). None of the included studies surveyed a sample of children, adolescents and adults giving specific data relating to exposure and number of ankle sprains for each distinct age group. Childhood and adolescence are considered to be periods of development in which the individual is at an amplified risk of injury (205). Appropriate neuromuscular control is ubiquitous to the successful completion of dynamic sporting manoeuvres. Whereas preferred patterns of coordination are established in adults ((206, 207), young children do not show the same consistency in patterns of coordination (208). Similarly, increased 'motor awkwardness' during adolescence may result from an immaturely developed sensorimotor system, thus increasing the challenge of even simple motor control tasks (204). The increased risk of ankle sprain in children and adolescents compared to adults could therefore be the result of a developing dynamic motor control system exploring the state space of movement patterns prior to settling in a number of preferred movement 'attractor' states (209, 210).

Meta-analysis by sport category revealed that indoor and court sports (7 per 1000 cumulative exposures) had the highest risk of ankle sprain followed by ice and water sports (3.7 per 1000 cumulative exposures), field sports (0.9 per 1000 exposures) and finally outdoor sports (0.87 per 1000 exposures). Pooled prevalence estimates revealed that ice/water sports had the lowest prevalence of ankle sprains of the 4 sub-groups of sport. The high incidence rate combined with low prevalence period can be explained by a higher overall incidence of injury in these sports but a greater tendency toward shoulder, knee and predominantly head injuries (34, 35).

Several studies not included in our analysis have previously reported that ankle sprain is one of the most common, if not the most common, injury in indoor and court sports such as basketball (211) (212-217), volleyball (218-221), tennis (222-224) and wrestling (225-227), thus explaining the trend for a higher risk of ankle sprain in indoor/court sports. There is also an abundance of literature investigating injury epidemiology in field based sports (98 of the studies included in our analysis were field-based focused). The high risk of ankle sprain has promoted an appropriate research response, as a large number of methodologically rigorous randomised control trials now exist investigating the effect of different interventions in injury rehabilitation (54, 228-231) and prevention (232-234).

In contrast to the clear disparity illustrated by the meta-analyses of incidence rate estimates between the subcategories of quality, gender, age and sport, meta-analyses of the same sub-ategories elucidated very similar prevalence period estimates.

Prevalence is a measure independent of exposure. Ninety-seven of 181 studies reported injury as a function of exposure. By incorporating exposure in the calculation of injury rates across a surveyed sample, incidence rate determines the number of events of interest occurring per projected amount of activity undertaken-thus providing an estimation of risk. In contrast, prevalence is a ratio of the number of the surveyed sample incurring an ankle sprain to the total sample, and is independent to the amount of activity undertaken. A possible reason for the contrasting findings between incidence rate and prevalence period is that in a given group or activity the proportion of people who sustain ankle sprains is similar, but the introduction of exposure separates these groups via the determination of risk per unit of activity completed; females and children are at a higher risk of sustaining an ankle sprain per exposure in the same activities compared to males or adolescents and adults, respectively. The disparity of incidence rate estimates by study quality and the lack thereof regarding prevalence period estimates cannot however be explained by the introduction of a unit of exposure. Rather, we propose that a study of higher quality will be predisposed to a more accurate determination of injury as a function of exposure, both in the correct and appropriate diagnosis of injury and the evaluation of levels of exposure for each surveyed subject.

Findings from the systematic review indicate that of the 3 most common clinical classifications of ankle sprain, lateral ankle sprain presents the greatest risk, followed by syndesmotic (high) ankle sprain and finally deltoid (medial) ligament sprain (based on incidence rate figures for exposure units of athlete exposure, year and hour)-see table 7. Only 6 of the 181 included studies reported sprain diagnosis without focusing on ankle sprain injury in isolation, giving sufficient data to determine incidence rate and/or prevalence period (45, 164, 235-237). Both a muscle driven computer simulation (238) and a cadaveric model (239)) have shown that plantarflexion and inversion increase strain on the lateral ligaments of the ankle. The higher risk of sustaining a lateral ligament sprain can be attributed to relative lower load to failure rate of the lateral ligamentous complex when compared to the medial and syndesmotic ligament groups (240) and reduced arthrokinematic restriction credited to decreased contact of the talus within the ankle mortise in the plantar-flexed and inverted position (241).

The systematic review identified that injury surveillance in military populations utilised varying measures of exposure, limiting the pooling of data. Seven studies were included in the review investigating military samples (43, 45, 242-246). Ankle sprain was reported per 1000 (parachute) jumps (3.8 lateral ankle sprains per 1000 jumps; 1.08 syndesmotic sprains per 1000 jumps) (45), per 1000 person-years (58.4 per 1000 person years) (166) and as a percentage, 2.8% in one study (43), and 17.7% in another (20).

These data outline the extent to which ankle sprain injury is a persistent and primary health concern for military populations-an abundance of available military epidemiology research also exists that didn't meet our inclusion criteria. Six papers surveying military populations were excluded from our analysis as they were retrospective in design (19, 247-251). In accordance with this, several intervention studies have been conducted with the primary aim of reducing in the incidence of ankle sprains in military populations (45, 252).

This is the first systematic review to incorporate meta-analyses of data from epidemiological studies relating to ankle sprain injury. A similar review was published in 2007 and included studies from 1977 to 2005 (29). Apart from the incorporation of meta-analyses of injury data, several key factors separate this study from the study by Fong et al (2007). The review by Fong et al. did not include military populations, did not use a rating system for the included studies and did not report specific data relating to sprain diagnosis. Another key difference is that for studies that reported the injury incidence for several body sites, the combined percentages were divided evenly for each included body site, thus introducing a critical source of bias. Furthermore, the search undertaken for the present study was completed in July 2012, and as such adds over 6 years of prospective evidence to the results presented in the review by Fong et al (2007).

Despite the strengths of this systematic review and meta-analyses, it is important to consider several limitations when interpreting the results. Studies were not included if they were published in non-English languages, which may influence the outcomes of our analyses, despite the probability that authors of high quality surveys would aim for publication in high-impact journals published in the English language in the pursuit of superior dissemination of output data.

It was also our intention to adhere to the framework outlined in the guidelines provided by the PRISMA statement (30). With specific reference to criteria 15 relating to the assessment of publication bias, we encountered difficulty in assessing and establishing the possibility of selective reporting of outcomes by individual studies. It was unfeasible to check if all the included 149 papers had published a protocol prior to their collection of data and compare the predicted outcomes to those published to determine any discrepancy. Furthermore, as required by our outlined inclusion criteria, all included studies reported the primary outcome – incidence rate or prevalence period, so there is no risk of selective reporting at an individual study level. Funnel plotting to determine cumulative risk of publication bias was considered to be more applicable to reviews involving interventional type studies, rather than descriptive epidemiology.

A number of methodological issues were identified among the included studies that should be addressed in future observational studies. Only 1 study scored full marks on the checklist developed for this analysis. We would recommend that epidemiological studies standardize their reporting according to the STROBE guidelines for reporting observational studies (31), thus allowing for proper interpretation of the available data to produce better estimates of incidence rate and prevalence period of ankle sprain injury (253).

5. Conclusions.

We found further evidence that individuals can incur an ankle sprain during various physical activity and sport activities. Female gender, lower age and athletes competing in indoor and court sports are the subgroups most at risk of ankle sprain. Lower quality studies are more likely to underestimate the risk of ankle sprain. Participants were at a significantly higher risk of sustaining a lateral ankle sprain compared with syndesmotic and medial ankle sprains. This analysis provides valuable information for researchers internationally in studies of epidemiology and intervention.

Table 1: The sub-categories of sport

Field Sports	Indoor + Court Sports	Ice/Water Sports	Outdoor Sports
American Football	Aeroball	Skiing	Orienteering
Australian Football	Basketball	Ice Hockey	Parachuting
Baseball	Cheerleading	Ice skating	Rock climbing
Cricket	Dance	Kitesurfing	Small wheel devices
Field Hockey	Floorball	Windsurfing	Trampoline
Gaelic Football	Gymnastics		Track and field
Lacrosse	Handball		Ultimate Frisbee.
Rugby	Netball		
Softball	Volleyball		
	Pole vault		
	Teamgym		
	Tennis		
	Wrestling		

<u>Table 2:</u> Pooled random effects estimates for ankle sprain incidence rate and prevalence period for the subgroups of study quality, gender, age and sport (95% CI).

	Cumulative Incidence per 1000 Exposures 8297.1. p<0.01 = 98.01%. n=98	**Incidence per 1000 Athlete Exposures**	**Incidence per 1000 Hours**	**Prevalence** 186945.32; p<0.01; = to 99.96%) n=160
High χ^2 17160.68. p<0.01 I^2 = 99.49%	0.12 (CI: 0.11 to 0.12). n=85			11.88% (CI: 10.56 to 13.19). n=116
Low χ^2 5171.39; p<0.01 I^2 = 99.07%	0.54 (CI: 0.49 to 0.59). n=12			11.19% (CI: 6.59 to 15.78). n=65
Male χ^2 14766.76; p<0.01 I^2 = 98.57%	6.94 (CI: 6.8 to 7.09). n=50	1.05 (CI: 0.78 to 1.31). n=24	6.16 (5.61 to 6.71). n=26	10.99% (CI: 10.84 to 11.15). n=86
Female χ^2 3337.87; p<0.01 I^2 = 98.71%	13.6 (CI: 13.25 to 13.94). n=32	1.17 (CI: 0.83 to 1.51). n=20	2.71 (CI: 1.71 to 3.71). n=12	10.55% (CI: 10.84 to 11.15). n=49
Child Q: 220.4; p<0.01 I^2 = 96.37%	2.85 (CI: 2.51 to 3.19). n=11			12.62% (CI: 11.81 to 13.43). n=15
Adolescent Q: 945.26; p<0.01 I^2 = 98.1%	1.94 (CI: 1.73 to 2.14). n=24			10.55% (CI: 9.92 to 11.17). n=32
Adult Q: 28813.04; p<0.01 I^2 = 99.69%	0.72 (CI: 0.67 to 0.77). n=97			11.41% (CI: 11.28 to 11.54). n=122
Field Sports Q: 19756.74; p<0.01 I^2 = 99.63%	1 (CI: 0.95 to 1.05). n=63	1.18 (CI: 0.86 to 1.50). n=26	3.85 (CI: 3.45 to 4.24). n=37	11.3% (CI: 11.15 to 11.44). n=101
Indoor/Court Sports Q: 6017.52; p<0.01 I^2 = 99.4%	7 (CI: 6.82 to 7.18). n=23	1.37 (CI: 1.05 to 1.7). n=16	4.9 (CI: 3.3 to 6.5). n=7	12.17% (CI: 12.01 to 12.33). n=44
Ice/Water Sports Q: 119.19; p<0.01 I^2 = 92.44%	3.74 (CI: 3.3 to 4.17). n=9	0.47 (CI: 0.22 to 0.71). n=6	0.5 (CI: 0.25 to 0.7). n=3	4.36% (CI:3.92 to 4.79). n=14
Outdoor Sports Q: 315.61; p<0.01 I^2 = 97.46%	0.88 (CI: 0.73 to 1.02). n=5			11.65% (CI: 11.33 to 11.97). n=13

Table 3: The incidences of lateral, medial and syndesmotic ankle sprain according to available data.

Diagnosis	Weighted prevalence period %	Incidence Per 1000:	Athlete exposures	Jumps	Days	Years	Hours
LATERAL	15.31		0.93	3.8	0.85	52.98	0.49
MEDIAL			0.06			2.19	0.2
SYNDESMOTIC			0.38	1.08		3.21	0.11

6. References

1. Cooke MW, Lamb SE, Marsh J, Dale J. A survey of current consultant practice of treatment of severe ankle sprains in emergency departments in the United Kingdom. Emerg Med J. 2003;20(6):505-7. Epub 2003/11/19.
2. Braun BL. Effects of ankle sprain in a general clinic population 6 to 18 months after medical evaluation. Arch Fam Med. 1999;8(2):143-8. Epub 1999/04/02.
3. Kerkhoffs GM, Rowe BH, Assendelft WJ, Kelly K, Struijs PA, van Dijk CN. Immobilisation and functional treatment for acute lateral ankle ligament injuries in adults. Cochrane Database Syst Rev. 2002(3):CD003762. Epub 2002/07/26.
4. Birrer RB, Fani-Salek MH, Totten VY, Herman LM, Politi V. Managing ankle injuries in the emergency department. J Emerg Med. 1999;17(4):651-60. Epub 1999/08/04.
5. Wilkerson GB, Horn-Kingery HM. Treatment of the inversion ankle sprain: comparison of different modes of compression and cryotherapy. The Journal of orthopaedic and sports physical therapy. 1993;17(5):240-6. Epub 1993/05/01.
6. McGowan RW, Pierce EF, Williams M, Eastman NW. Athletic injury and self diminution. J Sports Med Phys Fitness. 1994;34(3):299-304. Epub 1994/09/01.
7. Smith RW, Reischl SF. Treatment of ankle sprains in young athletes. The American journal of sports medicine. 1986;14(6):465-71. Epub 1986/11/01.
8. Gerber JP, Williams GN, Scoville CR, Arciero RA, Taylor DC. Persistent disability associated with ankle sprains: a prospective examination of an athletic population. Foot & Ankle International. 1998;19(10):653-60.
9. Verhagen RA, de Keizer G, van Dijk CN. Long-term follow-up of inversion trauma of the ankle. Arch Orthop Trauma Surg. 1995;114(2):92-6. Epub 1995/01/01.
10. van Rijn RM, van Os AG, Bernsen RM, Luijsterburg PA, Koes BW, Bierma-Zeinstra SM. What is the clinical course of acute ankle sprains? A systematic literature review. Am J Med. 2008;121(4):324-31 e6. Epub 2008/04/01.
11. Hertel J. Functional Anatomy, Pathomechanics, and Pathophysiology of Lateral Ankle Instability. J Athl Train. 2002;37(4):364-75. Epub 2003/08/26.
12. Delahunt E, Coughlan GF, Caulfield B, Nightingale EJ, Lin CW, Hiller CE. Inclusion criteria when investigating insufficiencies in chronic ankle instability. Med Sci Sports Exerc. 2010;42(11):2106-21. Epub 2010/03/31.
13. de Bie RA, de Vet HC, van den Wildenberg FA, Lenssen T, Knipschild PG. The prognosis of ankle sprains. Int J Sports Med. 1997;18(4):285-9. Epub 1997/05/01.
14. Verhagen EA, van Tulder M, van der Beek AJ, Bouter LM, van Mechelen W. An economic evaluation of a proprioceptive balance board training programme for the prevention of ankle sprains in volleyball. British journal of sports medicine. 2005;39(2):111-5. Epub 2005/01/25.
15. Lauder TD, Baker SP, Smith GS, Lincoln AE. Sports and physical training injury hospitalizations in the army. Am J Prev Med. 2000;18(3 Suppl):118-28. Epub 2000/03/29.
16. Songer TJ, LaPorte RE. Disabilities due to injury in the military. Am J Prev Med. 2000;18(3 Suppl):33-40. Epub 2000/03/29.

17. Sell TC, Abt JP, Crawford K, Lovalekar M, Nagai T, Deluzio JB, et al. Warrior Model for Human Performance and Injury Prevention: Eagle Tactical Athlete Program (ETAP) Part I. J Spec Oper Med. 2010;10(4):2-21. Epub 2011/03/29.
18. Bar-Dayan Y. Parachuting injuries: A retrospective study of 43,542 military jumps. Mil Med. 1998;163(1):1-2.
19. Billings CE. Epidemiology of injuries and illnesses during the United States Air Force Academy 2002 Basic Cadet Training program: documenting the need for prevention. Mil Med. 2004;169(8):664-70. Epub 2004/09/24.
20. Milgrom C, Shlamkovitch n, Finestone A, Eldad A, Laor A, Danon YL, et al. Risk factors for lateral ankle sprain: a prospective study among military recruits. Foot & Ankle International. 1991;12(1):26-30.
21. Lillywhite LP. Analysis of extrinsic factor associated with 379 injuries occurring during 34,236 military parachute descents. J R Army Med Corps. 1991;137(3):115-21. Epub 1991/10/01.
22. Kragh JF, Jr., Taylor DC. Parachuting injuries: a medical analysis of an airborne operation. Mil Med. 1996;161(2):67-9. Epub 1996/02/01.
23. Hiller CE, Nightingale EJ, Raymond J, Kilbreath SL, Burns J, Black DA, et al. Prevalence and Impact of Chronic Musculoskeletal Ankle Disorders in the Community. Arch Phys Med Rehabil. 2012. Epub 2012/05/12.
24. Valderrabano V, Hintermann B, Horisberger M, Fung TS. Ligamentous Posttraumatic Ankle Osteoarthritis. American Journal of Sports Medicine. 2006;34(4):612-20.
25. Hirose K, Murakami G, Minowa T, Kura H, Yamashita T. Lateral ligament injury of the ankle and associated articular cartilage degeneration in the talocrural joint: anatomic study using elderly cadavers. J Orthop Sci. 2004;9(1):37-43. Epub 2004/02/10.
26. Croy T, Saliba SA, Saliba E, Anderson MW, Hertel J. Differences in Lateral Ankle Laxity Measured via Stress Ultrasonography in Individuals With Chronic Ankle Instability, Ankle Sprain Copers, and Healthy Individuals. The Journal of orthopaedic and sports physical therapy. 2012;42(7):593-600. Epub 2012/03/27.
27. Hass CJ, Bishop MD, Doidge D, Wikstrom EA. Chronic Ankle Instability Alters Central Organization of Movement. American Journal of Sports Medicine. 2010;38(4):829-34.
28. Wikstrom EA, Bishop MD, Inamdar AD, Hass CJ. Gait Termination Control Strategies Are Altered in Chronic Ankle Instability Subjects. Med Sci Sports Exerc. 2010;42(1):197-205.
29. Fong DT, Hong Y, Chan LK, Yung PS, Chan KM. A systematic review on ankle injury and ankle sprain in sports. Sports Med. 2007;37(1):73-94. Epub 2006/12/28.
30. Knobloch K Fau - Yoon U, Yoon U Fau - Vogt PM, Vogt PM, Swartz MK, Moher D, Moher D Fau - Liberati A, et al. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement and publication bias

The PRISMA statement: a guideline for systematic reviews and meta-analyses

Corrigendum to: Preferred Reporting Items For Systematic Reviews And Meta-Analyses: The PRISMA Statement International Journal of Surgery 2010; 8: 336-341

Reprint--preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement

Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement

The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. (1878-4119 (Electronic)).
31. von Elm E Fau - Altman DG, Altman Dg Fau - Egger M, Egger M Fau - Pocock SJ, Pocock Sj Fau - Gotzsche PC, Gotzsche Pc Fau - Vandenbroucke JP, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. (1044-3983 (Print)).

32. Neyeloff Jl Fau - Fuchs SC, Fuchs Sc Fau - Moreira LB, Moreira LB. Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. (1756-0500 (Electronic)).
33. Higgins Jp Fau - Thompson SG, Thompson Sg Fau - Deeks JJ, Deeks Jj Fau - Altman DG, Altman DG. Measuring inconsistency in meta-analyses. (1756-1833 (Electronic)).
34. Agel J, Dick R, Nelson B, Marshall SW, Dompier TP. Descriptive epidemiology of collegiate women's ice hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 2000-2001 through 2003-2004. J Athl Train. 2007;42(2):249-54. Epub 2007/08/22.
35. Agel J, Dompier TP, Dick R, Marshall SW. Descriptive epidemiology of collegiate men's ice hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):241-8. Epub 2007/08/22.
36. Agel J, Evans TA, Dick R, Putukian M, Marshall SW. Descriptive epidemiology of collegiate men's soccer injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. J Athl Train. 2007;42(2):270-7. Epub 2007/08/22.
37. Agel J, Olson DE, Dick R, Arendt EA, Marshall SW, Sikka RS. Descriptive epidemiology of collegiate women's basketball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):202-10. Epub 2007/08/22.
38. Agel J, Palmieri-Smith RM, Dick R, Woitys EM, Marshall SW. Descriptive epidemiology of collegiate women's volleyball injuries: National Collegiate Athletic Association injury surveillance system, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):295-302.
39. Agel J, Ransone J, Dick R, Oppliger R, Marshall SW. Descriptive epidemiology of collegiate men's wrestling injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):303-10. Epub 2007/08/22.
40. Albright JP, Powell JW, Martindale A, Black R, Crowley E, Schmidt P, et al. Injury patterns in big ten conference football. The American journal of sports medicine. 2004;32(6):1394-404. Epub 2004/08/18.
41. Almeida SA, Trone DW, Leone DM, Shaffer RA, Patheal SL, Long K. Gender differences in musculoskeletal injury rates: a function of symptom reporting? Med Sci Sports Exerc. 1999;31(12):1807-12. Epub 1999/12/29.
42. Alonso JM, Tscholl PM, Engebretsen L, Mountjoy M, Dvorak J, Junge A. Occurrence of injuries and illnesses during the 2009 IAAF World Athletics Championships. British journal of sports medicine. 2010;44(15):1100-5. Epub 2010/11/26.
43. Amako M, Oda T, Masuoka K, Yokoi H, Campisi P. Effect of static stretching on prevention of injuries for military recruits. Mil Med. 2003;168(6):442-6.
44. Amamilo SC, Samuel AW, Hesketh KT, Moynihan FJ. A prospective study of parachute injuries in civilians. J Bone Joint Surg Br. 1987;69(1):17-9. Epub 1987/01/01.
45. Amoroso PJ, Ryan JB, Bickley B, Leitschuh P, Taylor DC, Jones BH. Braced for impact: reducing military paratroopers' ankle sprains using outside-the-boot braces. J Trauma. 1998;45(3):575-80. Epub 1998/09/29.
46. Andersen TE, Floerenes TW, Arnason A, Bahr R. Video analysis of the mechanisms for ankle injuries in football. The American journal of sports medicine. 2004;32(1 Suppl):69S-79S. Epub 2004/02/03.
47. Aoki H, O'Hata N, Kohno T, Morikawa T, Seki J. A 15-year prospective epidemiological account of acute traumatic injuries during official professional soccer league matches in Japan. The American journal of sports medicine. 2012;40(5):1006-14. Epub 2012/03/13.
48. Arnason A, Tenga A, Engebretsen L, Bahr R. A prospective video-based analysis of injury situations in elite male football - Football incident analysis. American Journal of Sports Medicine. 2004;32(6):1459-65.
49. Astrid J. Injury risk of playing football in Futsal World Cups. British journal of sports medicine. 2010;44(15):1089-92.

50. Backous DD, Friedl KE, Smith NJ, Parr TJ, Carpine WD, Jr. Soccer injuries and their relation to physical maturity. Am J Dis Child. 1988;142(8):839-42. Epub 1988/08/01.
51. Bahr R, Bahr IA. Incidence of acute volleyball injuries: a prospective cohort study of injury mechanisms and risk factors. / Incidence des lesions aigues en volley-ball: etude prospective en cohorte des mecanismes des blessures et des facteurs de risque. Scand J Med Sci Sports. 1997;7(3):166-71.
52. Baumhauer JF, Alosa DM, Renstrom FH, Trevino S, Beynnon B. A prospective study of ankle injury risk factors. American Journal of Sports Medicine. 1995;23(5):564-70.
53. Beneka A, Malliou P, Gioftsidou A, Tsigganos G, Zetou H, Godolias G. Injury incidence rate, severity and diagnosis in male volleyball players. Sport Sciences for Health. 2010;5(3):93-9.
54. Bennell K. Neuromuscular training reduces the risk of leg injuries in female floorball players. Australian Journal of Physiotherapy. 2008;54(4):282-.
55. Beynnon BD, Renstrom PA, Alosa DM, Baumhauer JF, Vacek PM. Ankle ligament injury risk factors: a prospective study of college athletes. Journal of Orthopaedic Research. 2001;19(2):213-20.
56. Beynnon BD, Vacek PM, Murphy D, Alosa D, Paller D. First-time inversion ankle ligament trauma: the effects of sex, level of competition, and sport on the incidence of injury. The American journal of sports medicine. 2005;33(10):1485-91. Epub 2005/07/13.
57. Bird YN, Waller AE, Marshall SW, Alsop JC, Chalmers DJ, Gerrard DF. The New Zealand Rugby Injury and Performance Project: V. Epidemiology of a season of rugby injury. British journal of sports medicine. 1998;32(4):319-25. Epub 1998/12/29.
58. Bottini E, Poggi EJT, Luzuriaga F, Secin FP. Incidence and nature of the most common rugby injuries sustained in Argentina (1991-1997). British journal of sports medicine. 2000;34(2):94-7.
59. Brito J, Rebelo A, Soares JM, Seabra A, Krustrup P, Malina RM. Injuries in youth soccer during the preseason. Clin J Sport Med. 2011;21(3):259-60. Epub 2011/04/14.
60. Brooks JH, Fuller CW, Kemp SP, Reddin DB. Epidemiology of injuries in English professional rugby union: part 2 training Injuries. British journal of sports medicine. 2005;39(10):767-75. Epub 2005/09/27.
61. Brooks JH, Fuller CW, Kemp SP, Reddin DB. Epidemiology of injuries in English professional rugby union: part 1 match injuries. British journal of sports medicine. 2005;39(10):757-66. Epub 2005/09/27.
62. Brudvik C. Injuries caused by small wheel devices. Prevention Science. 2006;7(3):313-20.
63. Cloke DJ, Ansell P, Avery P, Deehan D. Ankle injuries in football academies: a three-centre prospective study. British journal of sports medicine. 2011;45(9):702-8.
64. Cumps E, Verhagen E, Meeusen R. Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball. Journal of Sports Science & Medicine. 2007;6(2):212-9.
65. Dick R, Ferrara MS, Agel J, Courson R, Marshall SW, Hanley MJ, et al. Descriptive epidemiology of collegiate men's football injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):221-33. Epub 2007/08/22.
66. Dick R, Hertel J, Agel J, Grossman J, Marshall SW. Descriptive epidemiology of collegiate men's basketball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):194-201. Epub 2007/08/22.
67. Dick R, Hootman JM, Agel J, Vela L, Marshall SW, Messina R. Descriptive epidemiology of collegiate women's field hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. J Athl Train. 2007;42(2):211-20. Epub 2007/08/22.
68. Dick R, Lincoln AE, Agel J, Carter EA, Marshall SW, Hinton RY. Descriptive epidemiology of collegiate women's lacrosse injuries: National Collegiate Athletic Association injury surveillance system, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):262-9.

69. Dick R, Putukian M, Agel J, Evans TA, Marshall SW. Descriptive epidemiology of collegiate women's soccer injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. J Athl Train. 2007;42(2):278-85. Epub 2007/08/22.
70. Dick R, Romani WA, Agel J, Case JG, Marshall SW. Descriptive epidemiology of collegiate men's lacrosse injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):255-61. Epub 2007/08/22.
71. Dick R, Sauers EL, Agel J, Keuter G, Marshall SW, McCarty K, et al. Descriptive epidemiology of collegiate men's baseball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):183-93. Epub 2007/08/22.
72. Dompier TP, Powell JW, Barron MJ, Moore MT. Time-loss and non-time-loss injuries in youth football players. J Athl Train. 2007;42(3):395-402. Epub 2007/12/07.
73. Doyle C, George K. Injuries associated with elite participation in women's rugby over a competitive season: an initial investigation. Physical Therapy in Sport. 2004;5(1):44-50.
74. Dvorak J, Junge A, Derman W, Schwellnus M. Injuries and illnesses of football players during the 2010 FIFA World Cup. British journal of sports medicine. 2011;45(8):626-30.
75. Dvorak J, Junge A, Grimm K, Kirkendall D. Medical report from the 2006 FIFA World Cup Germany. British journal of sports medicine. 2007;41(9):578-81; discussion 81. Epub 2007/05/19.
76. Dyson R, Buchanan M, Hale T. Incidence of sports injuries in elite competitive and recreational windsurfers. British journal of sports medicine. 2006;40(4):346-50.
77. Ekstrand J, Gillquist J, Moller M, Oberg B, Liljedahl SO. Incidence of soccer injuries and their relation to training and team success. The American journal of sports medicine. 1983;11(2):63-7. Epub 1983/03/01.
78. Ekstrand J, Hagglund M, Walden M. Epidemiology of muscle injuries in professional football (soccer). The American journal of sports medicine. 2011;39(6):1226-32. Epub 2011/02/22.
79. Ekstrand J, Karlsson J.
80. Emery CA, Meeuwisse WH, Hartmann SE. Evaluation of Risk Factors for Injury in Adolescent Soccer Implementation and Validation of an Injury Surveillance System. American Journal of Sports Medicine. 2005;33(12):1882-91.
81. Faude O, Junge A, Kindermann W, Dvorak J. Injuries in female soccer players - A prospective study in the German national league. American Journal of Sports Medicine. 2005;33(11):1694-700.
82. Feeley BT, Kennelly S, Barnes RP, Muller MS, Kelly BT, Rodeo SA, et al. Epidemiology of National Football League training camp injuries from 1998 to 2007. The American journal of sports medicine. 2008;36(8):1597-603. Epub 2008/04/30.
83. Finestone A, Novack V, Farfel A, Berg A, Amir H, Milgrom C. A prospective study of the effect of foot orthoses composition and fabrication on comfort and the incidence of overuse injuries. Foot & Ankle International. 2004;25(7):462-6.
84. Flik K, Lyman S, Marx RG. American Collegiate Men's Ice Hockey: An Analysis of Injuries. American Journal of Sports Medicine. 2005;33(2):183-7.
85. Fourchet F, Horobeanu C, Loepelt H, Taiar R, Millet GP. Foot, Ankle, and Lower Leg Injuries in Young Male Track and Field Athletes. International Journal of Athletic Therapy & Training. 2011;16(3):19-23.
86. Frey C, Feder KS, Sleight J. Prophylactic ankle brace use in high school volleyball players: a prospective study. Foot Ankle Int. 2010;31(4):296-300. Epub 2010/04/08.
87. Fuller CW, Taylor A, Molloy MG. Epidemiological Study of Injuries in International Rugby Sevens. Clinical Journal of Sport Medicine. 2010;20(3):179-84.
88. Gabbe BJ, Finch CF, Wajswelner H, Bennell KL. Predictors of Lower Extremity Injuries at the Community Level of Australian Football. Clinical Journal of Sport Medicine. 2004;14(2):56-63.
89. Garrick JG, Requa RK. Injury patterns in children and adolescent skiers. The American journal of sports medicine. 1979;7(4):245-8. Epub 1979/07/01.

90. Gaulrapp H, Becker A, Walther M, Hess H. Injuries in women's soccer: a 1-year all players prospective field study of the women's Bundesliga (German premier league). Clin J Sport Med. 2010;20(4):264-71. Epub 2010/07/08.
91. Gibbs N. Injuries in professional rugby league. A three-year prospective study of the South Sydney Professional Rugby League Football Club. The American journal of sports medicine. 1993;21(5):696-700. Epub 1993/09/01.
92. Giza E, Fuller C, Junge A, Dvorak J. Mechanisms of foot and ankle injuries in soccer. The American journal of sports medicine. 2003;31(4):550-4. Epub 2003/07/16.
93. Hagglund M, Walden M, Ekstrand J. Previous injury as a risk factor for injury in elite football: a prospective study over two consecutive seasons. British journal of sports medicine. 2006;40(9):767-72. Epub 2006/07/21.
94. Harringe ML, Renström P, Werner S. Injury incidence, mechanism and diagnosis in top-level teamgym: a prospective study conducted over one season. Scand J Med Sci Sports. 2007;17(2):115-9.
95. Hjelm N, Werner S, Renstrom P. Injury profile in junior tennis players: a prospective two year study. Knee Surgery Sports Traumatology Arthroscopy. 2010;18(6):845-50.
96. Hosea TM, Carey CC, Harrer MF. The gender issue: epidemiology of ankle injuries in athletes who participate in basketball. Clin Orthop Relat Res. 2000(372):45-9. Epub 2000/03/30.
97. Hudash GW, Albright JP. Women's intercollegiate gymnastics. Injury patterns and "permanent" medical disability. American Journal of Sports Medicine. 1993;21(2):314-20.
98. Johansson C. Injuries in elite orienteers. The American journal of sports medicine. 1986;14(5):410-5. Epub 1986/09/01.
99. Johansson C. Training, injury and disease in senior and junior elite orienteers. Scientific Journal of Orienteering. 1988;4(1):3-13.
100. Johnson RJ, Ettlinger CF, Campbell RJ, Pope MH. Trends in skiing injuries. Analysis of a 6-year study (1972 to 1978). The American journal of sports medicine. 1980;8(2):106-13. Epub 1980/03/01.
101. Jones BH, Cowan DN, Tomlinson JP, Robinson JR, Polly DW, Frykman PN. Epidemiology of injuries associated with physical training among young men in the army. / Epidemiologie des blessures associees a l ' entrainement physique de jeunes gens a l ' armee. Medicine & Science in Sports & Exercise. 1993;25(2):197-203.
102. Junge A, Chomiak J, Dvorak J. Incidence of football injuries in youth players. Comparison of players from two European regions. The American journal of sports medicine. 2000;28(5 Suppl):S47-50. Epub 2000/10/14.
103. Junge A, Dvorak J. Injuries in female football players in top-level international tournaments. British journal of sports medicine. 2007;41 Suppl 1:i3-7. Epub 2007/08/19.
104. Junge A, Dvorak J. Injury risk of playing football in Futsal World Cups. British journal of sports medicine. 2010;44(15):1089-92.
105. Junge A, Dvorak J, Graf-Baumann T. Football injuries during the World Cup 2002. The American journal of sports medicine. 2004;32(1 Suppl):23S-7S. Epub 2004/02/03.
106. Junge A, Engebretsen L, Alonso JM, Renstrom P, Mountjoy M, Aubry M, et al. Injury surveillance in multi-sport events: the International Olympic Committee approach. British journal of sports medicine. 2008;42(6):413-21. Epub 2008/04/09.
107. Junge A, Engebretsen L, Mountjoy ML, Alonso JM, Renstrom P, Aubry MJ, et al. Sports Injuries During the Summer Olympic Games 2008. American Journal of Sports Medicine. 2009;37(11):2165-72.
108. Junge A, Lamprecht M, Stamm H, Hasler H, Bizzini M, Tschopp M, et al. Countrywide Campaign to Prevent Soccer Injuries in Swiss Amateur Players. American Journal of Sports Medicine. 2011;39(1):57-63.
109. Junge A, Langevoort G, Pipe A, Peytavin A, Wong F, Mountjoy M, et al. Injuries in Team Sport Tournaments During the 2004 Olympic Games. American Journal of Sports Medicine. 2006;34(4):565-76.

110. Junge A, Rosch D, Peterson L, Graf-Baumann T, Dvorak J. Prevention of soccer injuries: A prospective intervention study in youth amateur players. American Journal of Sports Medicine. 2002;30(5):652-9.
111. Kirkpatrick DP, Hunter RE, Janes PC, Mastrangelo J, Nicholas RA. The snowboarder's foot and ankle. American Journal of Sports Medicine. 1998;26(2):271-7.
112. Kofotolis N, Kellis E. Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players. J Athl Train. 2007;42(3):388-94.
113. Kostopoulos N, Dimitrios P. Injuries in Basketball. Biology of Exercise. 2010;6(1):47-55.
114. Kucera KL, Marshall SW, Kirkendall DT, Marchak PM, Garrett WE, Jr. Injury history as a risk factor for incident injury in youth soccer. British journal of sports medicine. 2005;39(7):462. Epub 2005/06/25.
115. Langevoort G, Myklebust G, Dvorak J, Junge A. Handball injuries during major international tournaments. Scand J Med Sci Sports. 2007;17(4):400-7. Epub 2006/10/14.
116. Le Gall F, Carling C, Reilly T. Injuries in young elite female soccer players. American Journal of Sports Medicine. 2008;36(2):276-84.
117. Le Gall F, Carling C, Reilly T, Vandewalle H, Church J, Rochcongar P. Incidence of injuries in elite French youth soccer players: a 10-season study. The American journal of sports medicine. 2006;34(6):928-38. Epub 2006/01/27.
118. Leary T, White JA. Acute injury incidence in professional county club cricket players (1985-1995). British journal of sports medicine. 2000;34(2):145-7. Epub 2000/04/29.
119. Linde F. Injuries in orienteering. British journal of sports medicine. 1986;20(3):125-7. Epub 1986/09/01.
120. Linko PE, Blomberg HK, Frilander HM. Orienteering competition injuries: injuries incurred in the Finnish Jukola and Venla relay competitions. / Blessures en competition de course d ' orientation: blessures repertoriees lors des competitions de relais "jukola et venla", en Finlande. British journal of sports medicine. 1997;31(3):205-8.
121. Maehlum S, Daljord OA. Acute sports injuries in Oslo: a one-year study. British journal of sports medicine. 1984;18(3):181-5.
122. Malliou P, Beneka A, Tsigganos G, Gioftsidou A, Germanou E, Michalopoulou M. Are injury rates in female volleyball players age related? Sport Sciences for Health. 2007;2(3):113-7.
123. Marchi AG, Di Bello D, Messi G, Gazzola G. Permanent sequelae in sports injuries: a population based study. Arch Dis Child. 1999;81(4):324-8.
124. Marfleet P. Ultimate injuries: a survey. British journal of sports medicine. 1991;25(4):235-40. Epub 1991/12/01.
125. Marshall SW, Covassin T, Dick R, Nassar LG, Agel J. Descriptive epidemiology of collegiate women's gymnastics injuries: National Collegiate Athletic Association injury surveillance system, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):234-40.
126. Marshall SW, Hamstra-Wright KL, Dick R, Grove KA, Agel J. Descriptive epidemiology of collegiate women's softball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. J Athl Train. 2007;42(2):286-94. Epub 2007/08/22.
127. McGuine TA, Brooks A, Hetzel S. The Effect of Lace-up Ankle Braces on Injury Rates in High School Basketball Players. American Journal of Sports Medicine. 2011;39(9):1840-8.
128. McGuine TA, Hetzel S, Wilson J, Brooks A. The Effect of Lace-up Ankle Braces on Injury Rates in High School Football Players. American Journal of Sports Medicine. 2012;40(1):49-57.
129. McMaster WC, Walter M. Injuries in soccer. The American journal of sports medicine. 1978;6(6):354-7. Epub 1978/11/01.
130. Michelson JD, Durant DM, McFarland E. The injury risk associated with pes planus in athletes. Foot Ankle Int. 2002;23(7):629-33. Epub 2002/07/31.
131. Nelson NG, McKenzie LB. Rock Climbing Injuries Treated in Emergency Departments in the US, 1990-2007. Am J Prev Med. 2009;37(3):195-200.

132. Nelson WE, DePalma B, Gieck JH, McCue FC, Kulund DN. Intercollegiate lacrosse injuries. Physician & Sportsmedicine. 1981;9(10):86-92.
133. Nickel C, Zernial O, Musahl V, Hansen U, Zantop T, Petersen W. A prospective study of kitesurfing injuries. American Journal of Sports Medicine. 2004;32(4):921-7.
134. Nysted M, Drogset JO. Trampoline injuries. British journal of sports medicine. 2006;40(12):984-7. Epub 2006/09/27.
135. Orchard J, Seward H. Epidemiology of injuries in the Australian Football League, seasons 1997-2000. British journal of sports medicine. 2002;36(1):39-44. Epub 2002/02/28.
136. Orchard J, Wood T, Seward H, Broad A. Comparison of injuries in elite senior and junior Australian football. Journal of Science & Medicine in Sport. 1998;1(2):82-8.
137. Pasanen K, Parkkari J, Kannus P, Rossi L, Palvanen M, Natri A, et al. Injury risk in female floorball: a prospective one-season follow-up. Scand J Med Sci Sports. 2008;18(1):49-54.
138. Price RJ, Hawkins RD, Hulse MA, Hodson A. The Football Association medical research programme: An audit of injuries in academy youth football. British journal of sports medicine. 2004;38(4):466-71.
139. Purdam C. A survey of netball and basketball injuries. Excel. 1987;3(3):9-11.
140. Putukian M, Knowles WK, Swere S, Castle NG. Injuries in indoor soccer - The Lake Placid Dawn to Dark Soccer Tournament. American Journal of Sports Medicine. 1996;24(3):317-22.
141. Ramirez M, Schaffer KB, Shen H, Kashani S, Kraus JF. Injuries to high school football athletes in California. The American journal of sports medicine. 2006;34(7):1147-58. Epub 2006/02/24.
142. Rebella GS, Edwards JO, Greene JJ, Husen MT, Brousseau DC. A prospective study of injury patterns in high school pole vaulters. The American journal of sports medicine. 2008;36(5):913-20. Epub 2008/03/11.
143. Romiti M, Finch CF, Gabbe B. A prospective cohort study of the incidence of injuries among junior Australian football players: evidence for an effect of playing-age level. British journal of sports medicine. 2008;42(6):441-6. Epub 2007/12/11.
144. Sadat-Ali M, Sankaran-Kutty M. Soccer injuries in Saudi Arabia. The American journal of sports medicine. 1987;15(5):500-2. Epub 1987/09/01.
145. Sankey RA, Brooks JHM, Kemp SPT, Haddad FS. The Epidemiology of Ankle Injuries in Professional Rugby Union Players. American Journal of Sports Medicine. 2008;36(12):2415-24.
146. Schafle MD, Requa RK, Patton WL, Garrick JG. Injuries in the 1987 national amateur volleyball tournament. / Blessures dans le cadre du tournoi national amateur de volleyball. American Journal of Sports Medicine. 1990;18(6):624-31.
147. Schick DM, Meeuwisse WH. Injury rates and profiles in female ice hockey players. American Journal of Sports Medicine. 2003;31(1):47-52.
148. Schick DM, Molloy MG, Wiley JP. Injuries during the 2006 Women's Rugby World Cup. British journal of sports medicine. 2008;42(6):447-51. Epub 2008/04/22.
149. Schulz MR, Marshall SW, Yang J, Mueller FO, Weaver NL, Bowling JM. A prospective cohort study of injury incidence and risk factors in North Carolina high school competitive cheerleaders. The American journal of sports medicine. 2004;32(2):396-405. Epub 2004/02/24.
150. Shields BJ, Fernandez SA, Smith GA. Epidemiology of cheerleading stunt-related injuries in the United States. J Athl Train. 2009;44(6):586-94. Epub 2009/11/17.
151. Shields BJ, Smith GA. Epidemiology of strain/sprain injuries among cheerleaders in the United States. American Journal of Emergency Medicine. 2011;29(9):1003-12.
152. Sinha A, McGlone RG, Montgomery K. Study of aeroball injuries. British journal of sports medicine. 1997;31(3):200-4.
153. Snellman K, Parkkari J, Kannus P, Leppala J, Vuori I, Jarvinen M. Sports injuries in floorball: a prospective one-year follow-up study. / Blessures au hockey sur parquet: etude prospective sur une annee. Int J Sports Med. 2001;22(7):531-6.
154. Soderman K, Adolphson J, Lorentzon R, Alfredson H. Injuries in adolescent female players in European football: a prospective study over one outdoor soccer season. / Blessures chez les

adolescentes jouant au football en Europe : etude prospective sur une saison de football en plein air. Scand J Med Sci Sports. 2001;11(5):299-304.
155. Solgard L, Nielsen AB, Moller-Madsen B, Jacobsen BW, Yde J, Jensen J. Volleyball injuries presenting in casualty: a prospective study. / Blessures dues au volleyball presentees en urgence: etude de prospection. British journal of sports medicine. 1995;29(3):200-4.
156. Starkey C. Injuries and illnesses in the National Basketball Association: A 10-year. J Athl Train. 2000;35(2):161-7.
157. Steffen K, Pensgaard AM, Bahr R. Self-reported psychological characteristics as risk factors for injuries in female youth football. Scand J Med Sci Sports. 2009;19(3):442-51. Epub 2008/04/26.
158. Tegnander A, Olsen O, Moholdt T, Engebretsen L, Bahr R. Injuries in Norwegian female elite soccer: a prospective one-season cohort study. Knee Surgery, Sports Traumatology, Arthroscopy. 2008;16(2):194-8.
159. Timpka T, Risto O, Bjormsjo M. Boys soccer league injuries: a community-based study of time-loss from sports participation and long-term sequelae. Eur J Public Health. 2008;18(1):19-24. Epub 2007/06/16.
160. Turbeville SD, Cowan LD, Asal NR, Owen WL, Anderson MA. Risk factors for injury in middle school football players. The American journal of sports medicine. 2003;31(2):276-81. Epub 2003/03/19.
161. Tyler TF, McHugh MP, Mirabella MR, Mullaney MJ, Nicholas SJ. Risk factors for noncontact ankle sprains in high school football players - The role of previous ankle sprains and body mass index. American Journal of Sports Medicine. 2006;34(3):471-5.
162. Verhagen E, van der Beek A, Twisk J, Bouter L, Bahr R, van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains: a prospective controlled trial. The American journal of sports medicine. 2004;32(6):1385-93. Epub 2004/08/18.
163. Volpi P, Pozzoni R, Galli M. The major traumas in youth football. Knee Surgery, Sports Traumatology, Arthroscopy. 2003;11(6):399-402.
164. Wadley GH, Albright JP. Women's intercollegiate gymnastics. Injury patterns and "permanent" medical disability. The American journal of sports medicine. 1993;21(2):314-20. Epub 1993/03/01.
165. Walden M, Hagglund M, Ekstrand J. Injuries in Swedish elite football - a prospective study on injury definitions, risk for injury and injury pattern during 2001. Scand J Med Sci Sports. 2005;15(2):118-25.
166. Waterman BR, Owens BD, Davey S, Zacchilli MA, Belmont PJ, Jr. The epidemiology of ankle sprains in the United States. J Bone Joint Surg Am. 2010;92(13):2279-84. Epub 2010/10/12.
167. Watson AW. Ankle sprains in players of the field-games Gaelic football and hurling. J Sports Med Phys Fitness. 1999;39(1):66-70. Epub 1999/05/07.
168. Watson AWS. Sports injuries in the game of hurling - A one-year prospective study. American Journal of Sports Medicine. 1996;24(3):323-8.
169. Watson MD, DiMartino PP. Incidence of injuries in high school track and field athletes and its relation to performance ability. The American journal of sports medicine. 1987;15(3):251-4. Epub 1987/05/01.
170. Wedderkopp N, Kaltoft M, Holm R, Froberg K. Comparison of two intervention programmes in young female players in European handball - with and without ankle disc. Scand J Med Sci Sports. 2003;13(6):371-5.
171. Wedderkopp N, Kaltoft M, Lundgaard B, Rosendahl M, Froberg K. Injuries in young female players in European team handball. Scand J Med Sci Sports. 1997;7(6):342-7.
172. Wheeler BR. Slow-pitch softball injuries. The American journal of sports medicine. 1984;12(3):237-40. Epub 1984/05/01.
173. Wiesler ER, Hunter M, Martin DF, Curl WW, Hoen H. Ankle flexibility and injury patterns in dancers. American Journal of Sports Medicine. 1996;24(6):754-7.

174. Wikstrom J, Andersson C. A prospective study of injuries in licensed floorball players. / Une etude prospective des blessures chez les joueurs licencies de balle au sol, sport pratique en Suede. Scand J Med Sci Sports. 1997;7(1):38-42.
175. Williamson DM, Lowdon IM. Ice-skating injuries. Injury. 1986;17(3):205-7. Epub 1986/05/01.
176. Woods C, Hawkins R, Hulse M, Hodson A. The Football Association Medical Research Programme: an audit of injuries in professional football: an analysis of ankle sprains. British journal of sports medicine. 2003;37(3):233-8.
177. Yard EE, Shcroeder MJ, Fields SK, Collins CL, Comstock RD. The Epidemiology of United States High School Soccer Injuries, 2005—2007. American Journal of Sports Medicine. 2008;36(10):1930-7.
178. Yde J, Nielsen AB. Sports injuries in adolescents' ball games: soccer, handball and basketball. / Les blessures dues a la pratique sportive dans les jeux de balle des adolescents: football, handball et basketball. British journal of sports medicine. 1990;24(1):51-4.
179. Zillmer DA, Powell JW, Albright JP. Gender-specific injury patterns in high school varsity basketball. Journal of Women's Health. 1992;1(1):69-76.
180. Cumps E, Verhagen E, Meeusen R. Prospective epidemiological study of basketball injuries during one competitive season: Ankle sprains and overuse knee injuries. Journal of Sports Science & Medicine. 2007;6(2):204-11.
181. Le Gall F, Carling C, Reilly T. Injuries in young elite female soccer players: an 8-season prospective study. The American journal of sports medicine. 2008;36(2):276-84. Epub 2007/10/13.
182. Junge A, Dvorak J, Graf-Baumann T, Peterson L. Football injuries during FIFA tournaments and the Olympic Games, 1998-2001: development and implementation of an injury-reporting system. The American journal of sports medicine. 2004;32(1 Suppl):80S-9S. Epub 2004/02/03.
183. Finch CF, Valuri G, Ozanne-Smith J. Injury surveillance during medical coverage of sporting events--development and testing of a standardised data collection form. J Sci Med Sport. 1999;2(1):42-56. Epub 1999/05/20.
184. Peterson L, Junge A, Chomiak J, Graf-Baumann T, Dvorak J. Incidence of football injuries and complaints in different age groups and skill-level groups. The American journal of sports medicine. 2000;28(5 Suppl):S51-7. Epub 2000/10/14.
185. Keller CS, Noyes FR, Buncher CR. The medical aspects of soccer injury epidemiology. The American journal of sports medicine. 1987;15(3):230-7. Epub 1987/05/01.
186. Levy IM. Formulation and sense of the NAIRS athletic injury surveillance system. The American journal of sports medicine. 1988;16 Suppl 1:S132-3. Epub 1988/01/01.
187. Hagglund M, Walden M, Bahr R, Ekstrand J. Methods for epidemiological study of injuries to professional football players: developing the UEFA model. British journal of sports medicine. 2005;39(6):340-6.
188. Verhagen E, Van der Beek AJ, Bouter LM, Bahr RM, Van Mechelen W. A one season prospective cohort study of volleyball injuries. British journal of sports medicine. 2004;38(4):477-81.
189. Harringe ML, Renstrom P, Werner S. Injury incidence, mechanism and diagnosis in top-level teamgym: a prospective study conducted over one season. Scand J Med Sci Sports. 2007;17(2):115-9. Epub 2007/03/31.
190. Wikstrom J, Andersson C. A prospective study of injuries in licensed floorball players. Scand J Med Sci Sports. 1997;7(1):38-42.
191. Schafle MD, Requa RK, Patton WL, Garrick JG. Injuries in the 1987 national amateur volleyball tournament. The American journal of sports medicine. 1990;18(6):624-31. Epub 1990/11/01.
192. Hosea TM, Carey CC, Harrer MF. The gender issue: Epidemiology of ankle injuries in athletes who participate in basketball. Clin Orthop Relat Res. 2000(372):45-9.
193. Nickel C, Xernial O, Musahl V, Hansen U, Zantop T, Petersen W. A Prospective Study of Kitesurfing Injuries. American Journal of Sports Medicine. 2004;32(4):921-7.
194. Ristolainen L, Heinonen A, Waller B, Kujala UM, Kettunen JA. Gender differences in sport injury risk and types of injuries: a retrospective twelve-month study on cross-country skiers,

swimmers, long-distance runners and soccer players. Journal of Sports Science & Medicine. 2009;8(3):443-51.
195. Rozzi SL, Lephart SM, Gear WS, Fu FH. Knee joint laxity and neuromuscular characteristics of male and female soccer and basketball players. The American journal of sports medicine. 1999;27(3):312-9. Epub 1999/06/03.
196. Quatman CE, Myer GD, Khoury J, Wall EJ, Hewett TE. Sex differences in "weightlifting" injuries presenting to United States emergency rooms. J Strength Cond Res. 2009;23(7):2061-7. Epub 2009/10/27.
197. Agel J, Bershadsky B, Arendt EA. Hormonal therapy: ACL and ankle injury. Med Sci Sports Exerc. 2006;38(1):7-12. Epub 2006/01/06.
198. Hesar NGZ, Calders P, Thijs Y, Roosen P, Witvrouw E. The influence of menstrual cycle on ankle proprioception. Isokinetics & Exercise Science. 2008;16(2):119-23.
199. Beaulieu ML, Lamontagne M, Xu LY. Lower limb muscle activity and kinematics of an unanticipated cutting manoeuvre: a gender comparison. Knee Surgery Sports Traumatology Arthroscopy. 2009;17(8):968-76.
200. Joseph MF, Rahl M, Sheehan J, MacDougall B, Horn E, Denegar CR, et al. Timing of Lower Extremity Frontal Plane Motion Differs Between Female and Male Athletes During a Landing Task. American Journal of Sports Medicine. 2011;39(7):1517-21.
201. McLean SG, Walker KB, Van den Bogert AJ. Effect of gender on lower extremity kinematics during rapid direction changes : an integrated analysis of three sports movements. Journal of Science & Medicine in Sport. 2005;8(4):411-22.
202. Hewett TE, Ford KR, Myer GD. Anterior cruciate ligament injuries in female athletes: Part 2, a meta-analysis of neuromuscular interventions aimed at injury prevention. The American journal of sports medicine. 2006;34(3):490-8. Epub 2005/12/31.
203. Lohmander LS, Ostenberg A, Englund M, Roos H. High prevalence of knee osteoarthritis, pain, and functional limitations in female soccer players twelve years after anterior cruciate ligament injury. Arthritis Rheum. 2004;50(10):3145-52. Epub 2004/10/12.
204. Quatman-Yates Cc Fau - Quatman CE, Quatman Ce Fau - Meszaros AJ, Meszaros Aj Fau - Paterno MV, Paterno Mv Fau - Hewett TE, Hewett TE. A systematic review of sensorimotor function during adolescence: a developmental stage of increased motor awkwardness? (1473-0480 (Electronic)).
205. Conn JM, Annest JL, Bossarte RM, Gilchrist J. Non-fatal sports and recreational violent injuries among children and teenagers, United States, 2001-2003. J Sci Med Sport. 2006;9(6):479-89. Epub 2006/04/20.
206. Kelso JA. Phase transitions and critical behavior in human bimanual coordination. (0002-9513 (Print)).
207. Kelso Ja Fau - Holt KG, Holt Kg Fau - Rubin P, Rubin P Fau - Kugler PN, Kugler PN. Patterns of human interlimb coordination emerge from the properties of non-linear, limit cycle oscillatory processes: theory and data. (0022-2895 (Print)).
208. Robertson Sd Fau - Zelaznik HN, Zelaznik Hn Fau - Lantero DA, Lantero Da Fau - Bojczyk KG, Bojczyk Kg Fau - Spencer RM, Spencer Rm Fau - Doffin JG, Doffin Jg Fau - Schneidt T, et al. Correlations for timing consistency among tapping and drawing tasks: evidence against a single timing process for motor control. (0096-1523 (Print)).
209. Davids K Fau - Glazier P, Glazier P Fau - Araujo D, Araujo D Fau - Bartlett R, Bartlett R. Movement systems as dynamical systems: the functional role of variability and its implications for sports medicine. (0112-1642 (Print)).
210. Davids K Fau - Glazier P, Glazier P. Deconstructing neurobiological coordination: the role of the biomechanics-motor control nexus. (1538-3008 (Electronic)).
211. Barrett JR, Tanji JL, Drake C, Fuller D, Kawasaki RI, Fenton RM. High- versus low-top shoes for the prevention of ankle sprains in basketball players. A prospective randomized study. The American journal of sports medicine. 1993;21(4):582-5. Epub 1993/07/01.

212. Borowski LA, Yard EE, Fields SK, Comstock RD. The epidemiology of US high school basketball injuries, 2005-2007. The American journal of sports medicine. 2008;36(12):2328-35. Epub 2008/09/04.
213. Chan KM, Yuan Y, Li CK, Chien P, Tsang G. Sports causing most injuries in Hong Kong. British journal of sports medicine. 1993;27(4):263-7. Epub 1993/12/01.
214. Gomez E, DeLee JC, Farney WC. Incidence of injury in Texas girls' high school basketball. American Journal of Sports Medicine. 1996;24(5):684-7.
215. Henry JH, Lareau B, Neigut D. The injury rate in professional basketball. The American journal of sports medicine. 1982;10(1):16-8. Epub 1982/01/01.
216. Zelisko JA, Noble HB, Porter M. A comparison of men's and women's professional basketball injuries. The American journal of sports medicine. 1982;10(5):297-9. Epub 1982/09/01.
217. Castro M, Janeira MA, Fernandes O, Cunha L. Biomechanical analysis of an inciting event of ankle sprain on basketball players. British journal of sports medicine. 2008;42(6):511-2.
218. Briner WW, Jr., Kacmar L. Common injuries in volleyball. Mechanisms of injury, prevention and rehabilitation. Sports Med. 1997;24(1):65-71. Epub 1997/07/01.
219. Gross P, Marti B. Risk of degenerative ankle joint disease in volleyball players: study of former elite athletes. Int J Sports Med. 1999;20(1):58-63. Epub 1999/03/25.
220. Reeser JC. Volleyball injury epidemiology. International Journal of Volleyball Research. 2000;3(1):26-30.
221. Reeser JC, Verhagen E, Briner WW, Askeland TI, Bahr R. Strategies for the prevention of volleyball related injuries. British journal of sports medicine. 2006;40(7):594-600; discussion 599-600. Epub 2006/06/27.
222. Hjelm N, Werner S, Renstrom P. Injury profile in junior tennis players: a prospective two year study. Knee Surg Sports Traumatol Arthrosc. 2010;18(6):845-50. Epub 2010/03/20.
223. Iwamoto J, Takeda T, Sato Y, Matsumoto H. Retrospective case evaluation of gender differences in sports injuries in a Japanese sports medicine clinic. Gend Med. 2008;5(4):405-14. Epub 2008/12/26.
224. Zecher SB, Leach RE. Lower leg and foot injuries in tennis and other racquet sports. Clin Sports Med. 1995;14(1):223-39. Epub 1995/01/01.
225. Jackson DS, Furman WK, Berson BL. Patterns of injuries in college athletes: a retrospective study of injuries sustained in intercollegiate athletics in two colleges over a two-year period. Mt Sinai J Med. 1980;47(4):423-6. Epub 1980/07/01.
226. Jarret GJ, Orwin JF, Dick RW. Injuries in collegiate wrestling. The American journal of sports medicine. 1998;26(5):674-80. Epub 1998/10/24.
227. Strauss RH, Lanese RR. Injuries among wrestlers in school and college tournaments. JAMA. 1982;248(16):2016-9. Epub 1982/10/22.
228. Bleakley CM, McDonough SM, MacAuley DC, Bjordal J. Cryotherapy for acute ankle sprains: a randomised controlled study of two different icing protocols. British journal of sports medicine. 2006;40(8):700-5; discussion 5. Epub 2006/04/14.
229. Bleakley CM, O'Connor SR, Tully MA, Rocke LG, Macauley DC, Bradbury I, et al. Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial. BMJ. 2010;340:c1964. Epub 2010/05/12.
230. Boyce SH, Quigley MA, Campbell S. Management of ankle sprains: a randomised controlled trial of the treatment of inversion injuries using an elastic support bandage or an Aircast ankle brace. British journal of sports medicine. 2005;39(2):91-6. Epub 2005/01/25.
231. Lamb SE, Marsh JL, Hutton JL, Nakash R, Cooke MW. Mechanical supports for acute, severe ankle sprain: a pragmatic, multicentre, randomised controlled trial. Lancet. 2009;373(9663):575-81. Epub 2009/02/17.
232. Emery CA, Meeuwisse WH. The effectiveness of a neuromuscular prevention strategy to reduce injuries in youth soccer: a cluster-randomised controlled trial. British journal of sports medicine. 2010;44(8):555-62.

233. Janssen KW, van Mechelen W, Verhagen E. Ankles back in randomized controlled trial (ABrCt): braces versus neuromuscular exercises for the secondary prevention of ankle sprains. Design of a randomised controlled trial. BMC Musculoskelet Disord. 2011;12.
234. Wedderkopp N, Kaltoft M, Lundgaard B, Rosendahl M, Froberg K. Prevention of injuries in young female players in European team handball. A prospective intervention study. Scand J Med Sci Sports. 1999;9(1):41-7. Epub 1999/02/12.
235. Sankey RA, Brooks JH, Kemp SP, Haddad FS. The epidemiology of ankle injuries in professional rugby union players. The American journal of sports medicine. 2008;36(12):2415-24. Epub 2008/09/10.
236. Starkey C. Injuries and illnesses in the National Basketball Association: a 10-year perspective. J Athl Train. 2000;35(2):161-7.
237. Waterman BR, Belmont Jr PJ, Cameron KL, DeBerardino TM, Owens BD. Epidemiology of Ankle Sprain at the United States Military Academy. American Journal of Sports Medicine. 2010;38(4):797-803.
238. Wright IC, Neptune RR, van den Bogert AJ, Nigg BM. The influence of foot positioning on ankle sprains. J Biomech. 2000;33(5):513-9. Epub 2000/03/10.
239. Konradsen L, Bech L, Ehrenbjerg M, Nickelsen T. Seven years follow-up after ankle inversion trauma. Scand J Med Sci Sports. 2002;12(3):129-35. Epub 2002/07/24.
240. Fong Dt Fau - Chan Y-Y, Chan Yy Fau - Mok K-M, Mok Km Fau - Yung PS, Yung Psh Fau - Chan K-M, Chan KM. Understanding acute ankle ligamentous sprain injury in sports. (1758-2555 (Electronic)).
241. Loudon Jk Fau - Bell SL, Bell SL. The foot and ankle: an overview of arthrokinematics and selected joint techniques. (1062-6050 (Print)).
242. Almeida SA, Williams KM, Shaffer RA, Brodine SK. Epidemiological patterns of musculoskeletal injuries and physical training. Med Sci Sports Exerc. 1999;31(8):1176-82.
243. Finestone A, Milgrom C, Evans R, Yanovich R, Constantini N, Moran DS. Overuse injuries in female infantry recruits during low-intensity basic training. Med Sci Sports Exerc. 2008;40(11 Suppl):S630-5. Epub 2008/10/14.
244. Jones BH, Bovee MW, Harris JM, 3rd, Cowan DN. Intrinsic risk factors for exercise-related injuries among male and female army trainees. The American journal of sports medicine. 1993;21(5):705-10. Epub 1993/09/01.
245. Milgrom C, Shlamkovitch N, Finestone A, Eldad A, Laor A, Danon YL, et al. Risk factors for lateral ankle sprain: a prospective study among military recruits. Foot Ankle. 1991;12(1):26-30. Epub 1991/08/01.
246. Waterman BR, Belmont PJ, Jr., Cameron KL, Deberardino TM, Owens BD. Epidemiology of ankle sprain at the United States Military Academy. The American journal of sports medicine. 2010;38(4):797-803. Epub 2010/02/11.
247. Belmont PJ, Jr., Goodman GP, Waterman B, DeZee K, Burks R, Owens BD. Disease and nonbattle injuries sustained by a U.S. Army Brigade Combat Team during Operation Iraqi Freedom. Mil Med. 2010;175(7):469-76. Epub 2010/08/06.
248. Davidson PL, Chalmers DJ, Wilson BD, McBride D. Lower limb injuries in New Zealand Defence Force personnel: descriptive epidemiology. Aust N Z J Public Health. 2008;32(2):167-73. Epub 2008/04/17.
249. Hughes CD, Weinrauch PCL. MILITARY STATIC LINE PARACHUTE INJURIES IN AN AUSTRALIAN COMMANDO BATTALION. ANZ J Surg. 2008;78(10):848-52.
250. Kragh JF, Jr., Taylor DC. Fast-roping injuries among Army Rangers: a retrospective survey of an elite airborne battalion. Mil Med. 1995;160(6):277-9. Epub 1995/06/01.
251. Miser WF, Doukas WC, Lillegard WA. Injuries and illnesses incurred by an army ranger unit during Operation Just Cause. Mil Med. 1995;160(8):373-80. Epub 1995/08/01.

252. Dettori JR, Pearson BD, Basmania CJ, Lednar WM. Early ankle mobilization, Part I: The immediate effect on acute, lateral ankle sprains (a randomized clinical trial). Mil Med. 1994;159(1):15-20. Epub 1994/01/01.
253. Jabs DA. Improving the reporting of clinical case series. (0002-9394 (Print)).

Table 1: The sub-categories of sport

Field Sports	Indoor + Court Sports	Ice/Water Sports	Outdoor Sports
American Football	Aeroball	Skiing	Orienteering
Australian Football	Basketball	Ice Hockey	Parachuting
Baseball	Cheerleading	Ice skating	Rock climbing
Cricket	Dance	Kitesurfing	Small wheel devices
Field Hockey	Floorball	Windsurfing	Trampoline
Gaelic Football	Gymnastics		Track and field
Lacrosse	Handball		Ultimate Frisbee.
Rugby	Netball		
Softball	Volleyball		
	Pole vault		
	Teamgym		
	Tennis		
	Wrestling		

Table 2
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Table 2: Pooled random effects estimates for ankle sprain incidence rate and prevalence period for the subgroups of study quality, gender, age and sport (95% CI).

	Cumulative Incidence per 1000 Exposures 8297.1. p<0.01 = 98.01%. n=98	**Incidence per 1000 Athlete Exposures**	**Incidence per 1000 Hours**	**Prevalence** 186945.32; p<0.01; = to 99.96%) n=160
High χ^2 17160.68. p<0.01 I^2 = 99.49%	0.12 (CI: 0.11 to 0.12). n=85			11.88% (CI: 10.56 to 13.19). n=116
Low χ^2 5171.39; p<0.01 I^2 = 99.07%	0.54 (CI: 0.49 to 0.59). n=12			11.19% (CI: 6.59 to 15.78). n=65
Male χ^2 14766.76; p<0.01 I^2 = 98.57%	6.94 (CI: 6.8 to 7.09). n=50	1.05 (CI: 0.78 to 1.31). n=24	6.16 (5.61 to 6.71). n=26	10.99% (CI: 10.84 to 11.15). n=86
Female χ^2 3337.87; p<0.01 I^2 = 98.71%	13.6 (CI: 13.25 to 13.94). n=32	1.17 (CI: 0.83 to 1.51). n=20	2.71 (CI: 1.71 to 3.71). n=12	10.55% (CI: 10.84 to 11.15). n=49
Child Q: 220.4; p<0.01 I^2 = 96.37%	2.85 (CI: 2.51 to 3.19). n=11			12.62% (CI: 11.81 to 13.43). n=15
Adolescent Q: 945.26; p<0.01 I^2 = 98.1%	1.94 (CI: 1.73 to 2.14). n=24			10.55% (CI: 9.92 to 11.17). n=32
Adult Q: 28813.04; p<0.01 I^2 = 99.69%	0.72 (CI: 0.67 to 0.77). n=97			11.41% (CI: 11.28 to 11.54). n=122
Field Sports Q: 19756.74; p<0.01 I^2 = 99.63%	1 (CI: 0.95 to 1.05). n=63	1.18 (CI: 0.86 to 1.50). n=26	3.85 (CI: 3.45 to 4.24). n=37	11.3% (CI: 11.15 to 11.44). n=101
Indoor/Court Sports Q: 6017.52; p<0.01 I^2 = 99.4%	7 (CI: 6.82 to 7.18). n=23	1.37 (CI: 1.05 to 1.7). n=16	4.9 (CI: 3.3 to 6.5). n=7	12.17% (CI: 12.01 to 12.33). n=44
Ice/Water Sports Q: 119.19; p<0.01 I^2 = 92.44%	3.74 (CI: 3.3 to 4.17). n=9	0.47 (CI: 0.22 to 0.71). n=6	0.5 (CI: 0.25 to 0.7). n=3	4.36% (CI:3.92 to 4.79). n=14
Outdoor Sports Q: 315.61; p<0.01 I^2 = 97.46%	0.88 (CI: 0.73 to 1.02). n=5			11.65% (CI: 11.33 to 11.97). n=13

Table 3: The incidences of lateral, medial and syndesmotic ankle sprain according to available data.

Diagnosis	Weighted prevalence period %	Incidence Per 1000:	Athlete exposures	Jumps	Days	Years	Hours
LATERAL	15.31		0.93	3.8	0.85	52.98	0.49
MEDIAL			0.06			2.19	0.2
SYNDESMOTIC			0.38	1.08		3.21	0.11

Figure 1

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Materials and Methods.	
1. Describe the setting or participating locations.	/1
2. Describe relevant dates (period of recruitment, exposure, follow-up, data collection).	/1
3. Statement concerning institutional review board approval and consent provided.	/1
4. Give the inclusion and exclusion criteria.	/1
5. Describe ankle injury history.	/1
6. Describe methods of follow-up.	/1
Data Sources/Measurement.	
1. Provide a definition of injury.	/1
2. Verification of injury by *independent* medical professional.	/1
3. Classification of injury (grade, medial / lateral).	/1
4. Indicate the number of participants with missing data and explain how this was addressed.	/1
5. Exposure data measured and presented.	/1
Final Score:	**/11**

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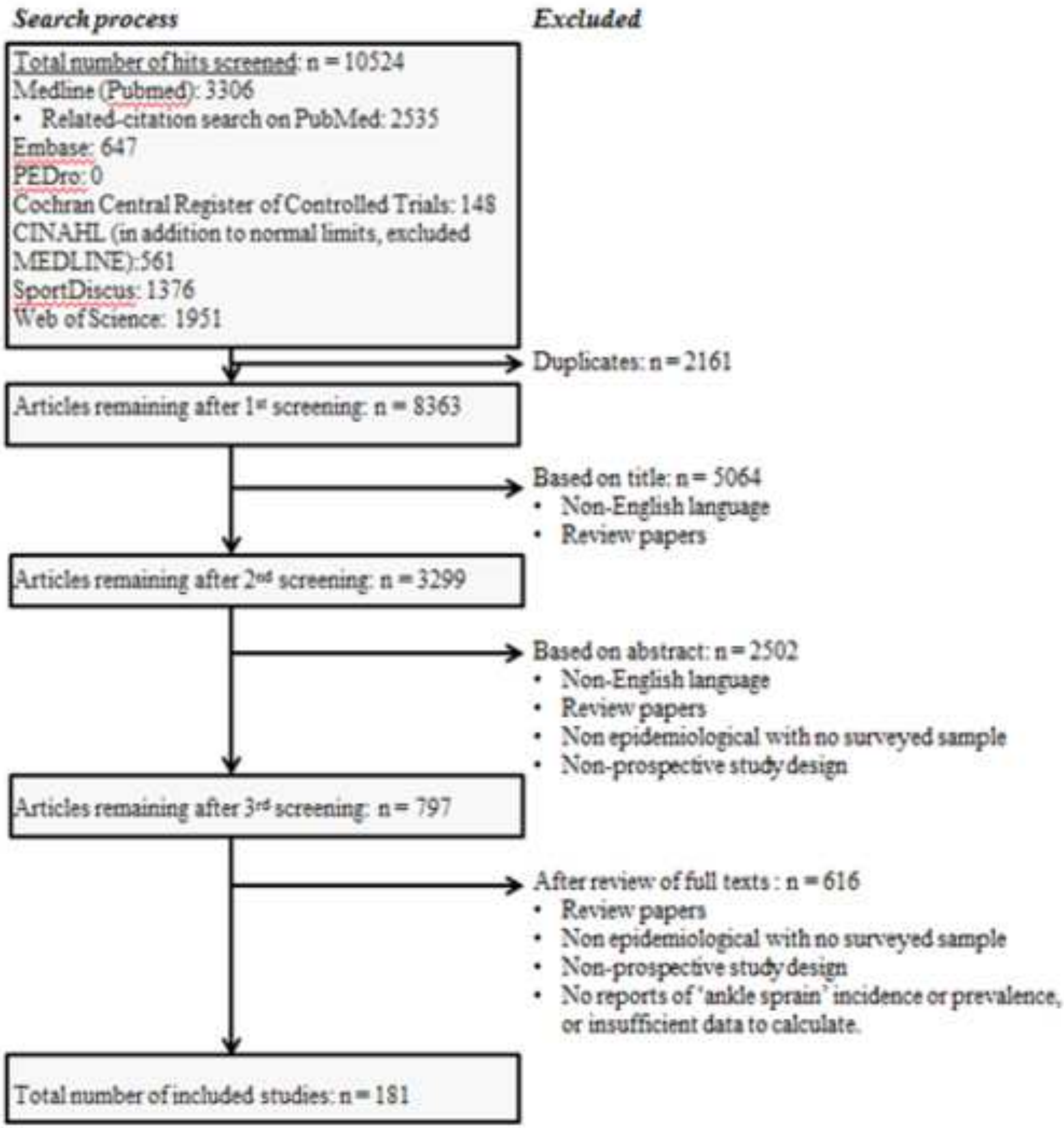

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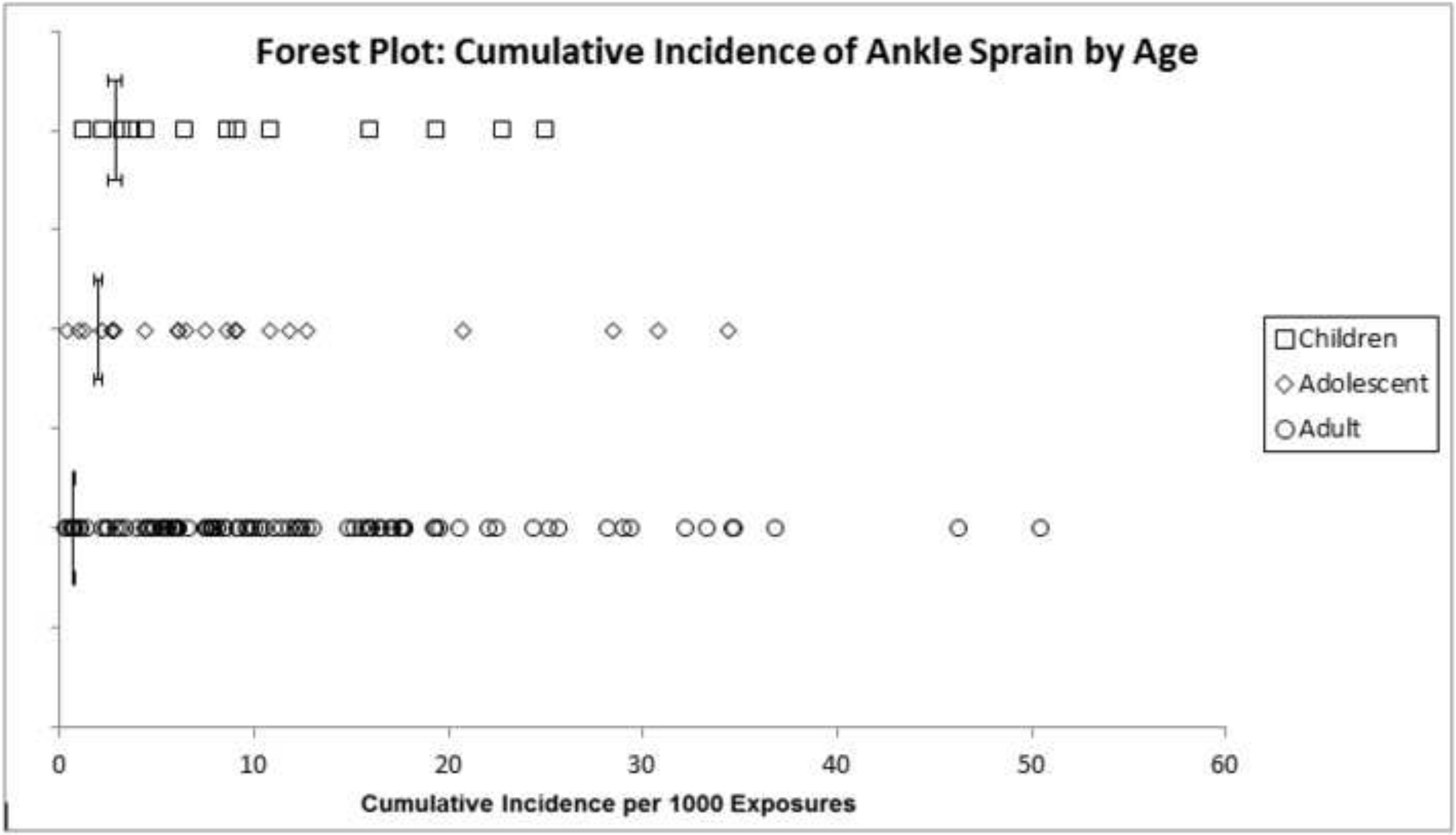

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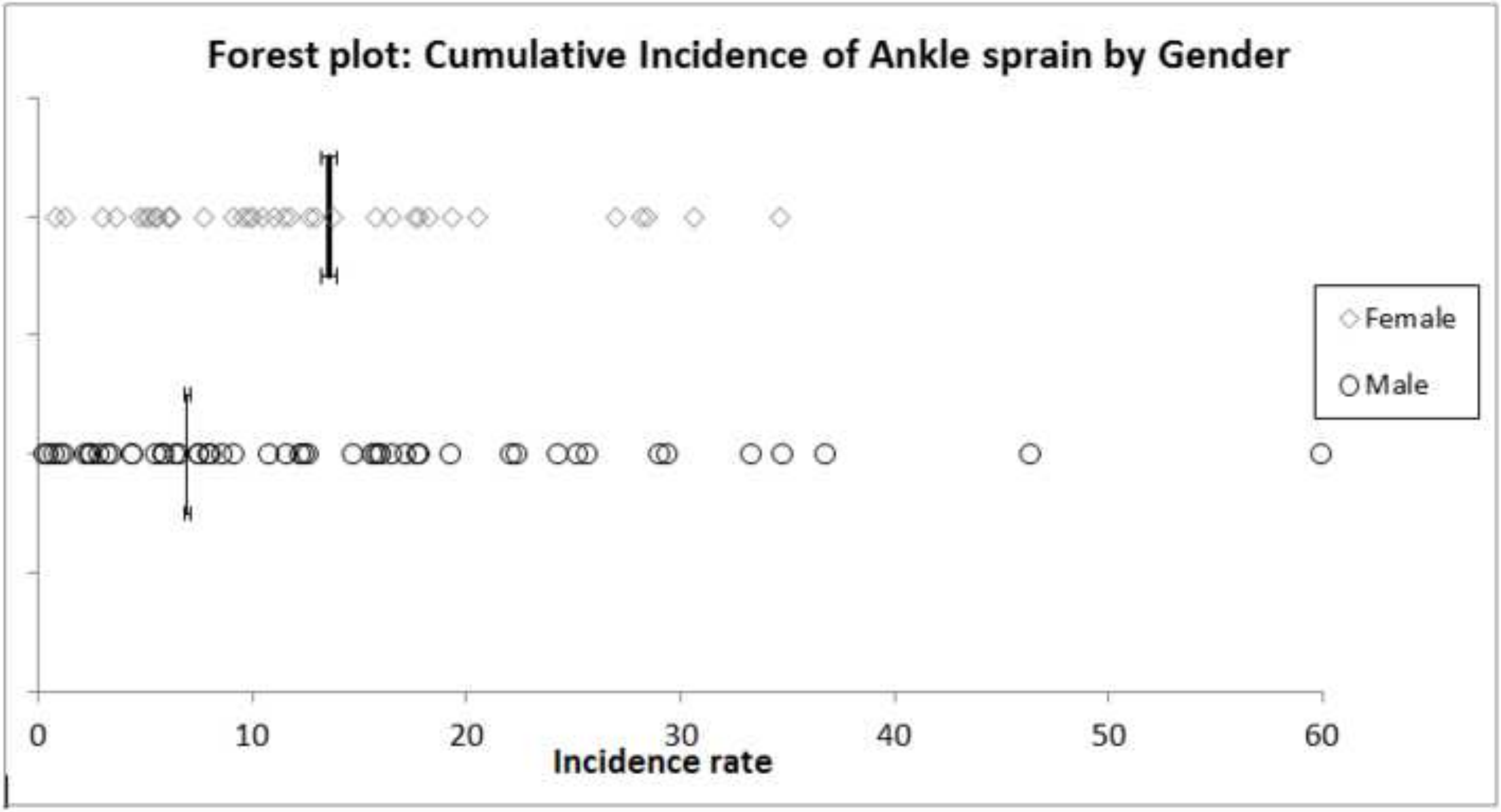

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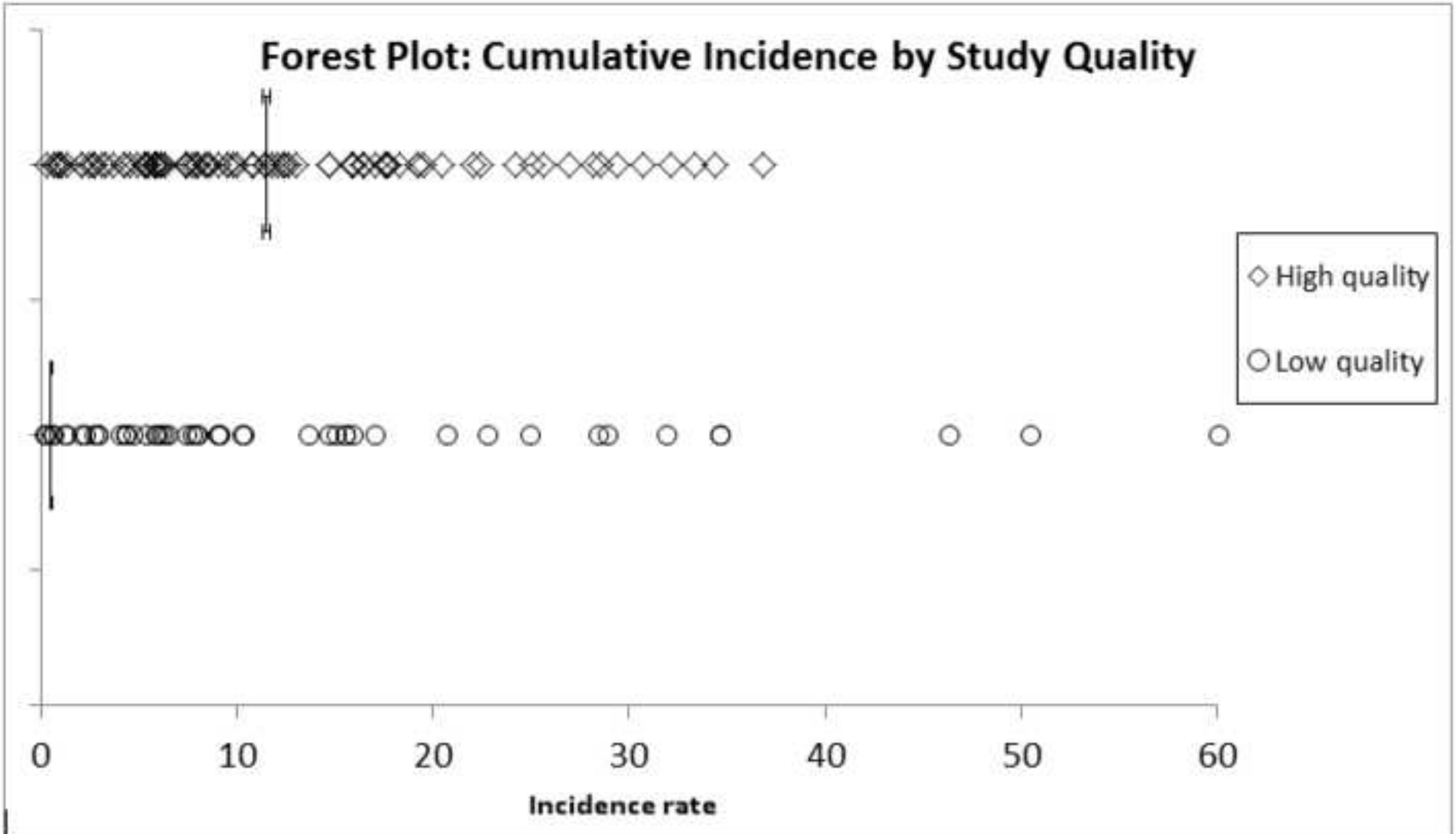

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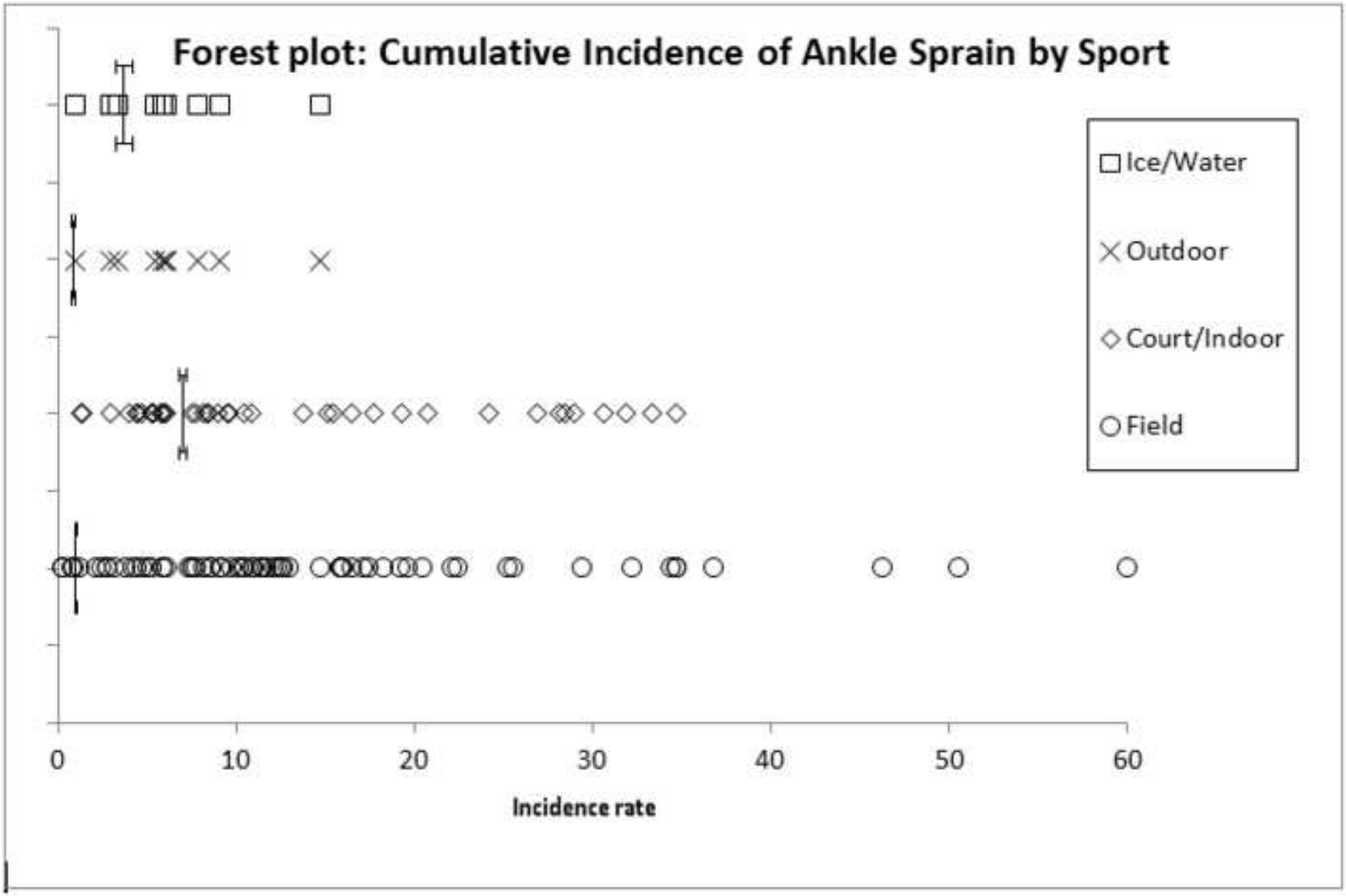

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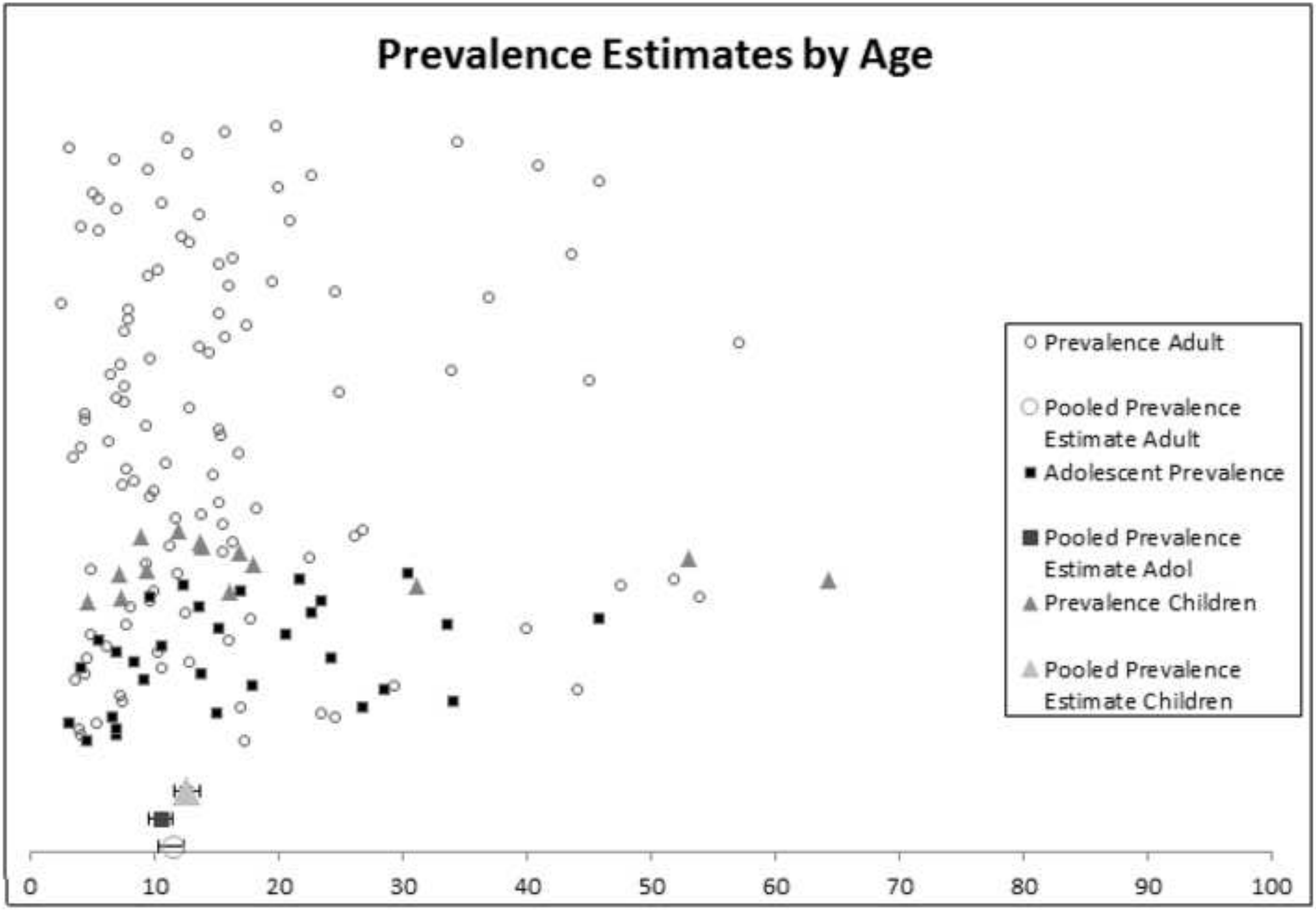

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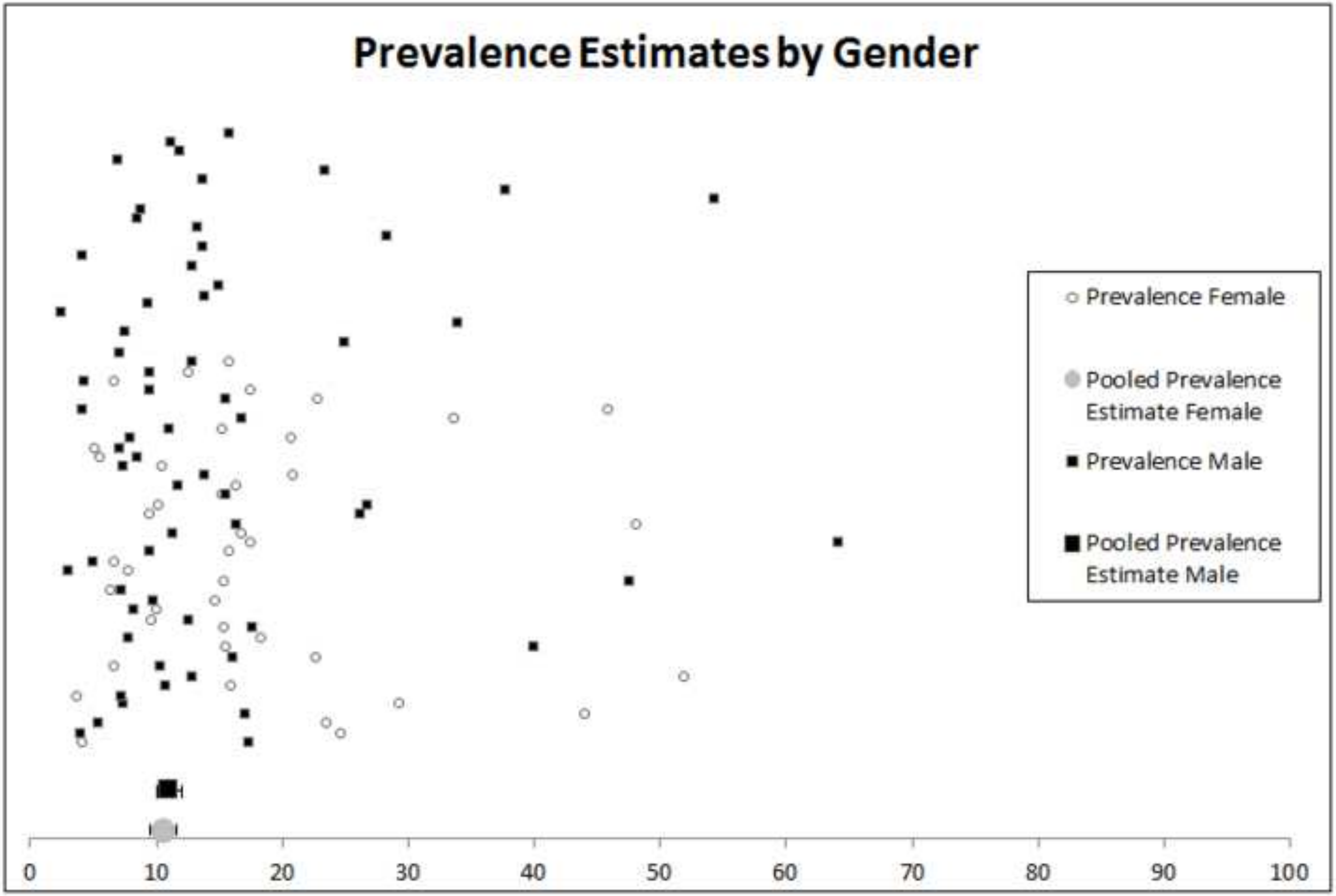

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