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ANTERIOR CRUCIATE LIGAMENT INJURY INCIDENCE ACROSS SEX, SPORT, AND COMPETITION LEVEL: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Context: Despite the efficacy of injury prevention programs, ACL injury rates have remained steady, which may be due to limited knowledge of which groups/athletes are greatest at risk of sustaining an ACL injury.

Objective: The purpose of our study was to characterize ACL injury rate (IR) across sports, sex, and levels of play to identify high-risk groups per season.

Data Sources: We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and searched electronic databases of PubMed and EBSCohost.

Study Selection: Inclusion criteria required that studies noted level of play, number of ACL injuries, and total number of athletes. We excluded studies if the injury was a secondary one, the total population was unclear or noted only cases of reconstruction.

Data Extraction: We extracted data on sport, sex, level of play, number of ACL injuries, and total number of athletes.

Data Synthesis: The electronic literature search yielded 9469 studies for initial review, and at the end of the search, a total of 89 studies were included in our meta-analysis. The highest risk sports were female semi-pro handball (IR=0.045/athlete-year), female professional basketball (IR=0.027/athlete-year), and female professional alpine skiing (IR=0.025/athlete-year). Across all the sports, sex and levels there were large gaps in the data and variability in the injury rates.

Conclusions: There was variability in injury risk rates across competition level, sex and sport, with the highest risk of ACL injury in semi-professional and professional sports. While female athletes demonstrated greater risk of ACL injury than male athletes, it’s unknown if this was true in every sport or level due to gaps in the data. Practitioners should understand the impact of sex and sport differences in ACL injury risk to guide the best evidenced-based risk reduction strategies.

Key Words: knee, incidence, epidemiology, tear, ACL

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Key points:

- Groupings with the most data entries included female (k=18) and male (k=15) professional soccer, female high school soccer (k=12), and female collegiate soccer (K=8).
- The highest risk sports were female semi-pro handball (IR=0.045/athlete-year), female professional basketball (IR=0.027/athlete-year), and female professional alpine skiing (IR=0.025/athlete-year).
- High variability in epidemiological studies makes it difficult to truly understand which athletes have the greatest need for ACL injury prevention programs.

INTRODUCTION

Former athletes with an ACL injury have a 4-fold increase in risk for osteoarthritis[1-5] and total knee replacement,[6] and experience impaired knee quality of life in 5-25 years.[7] Recovery time following ACL injury can be substantial, lasting approximately one year.[8-10] About 45% of injured athletes will not go return to competitive sport,[8,9,11] and even if return is possible, performance is likely to decrease.[10,12]

Evidence-based ACL injury prevention neuromuscular training reduces the risk of ACL injury by 50% (from 1 in 66 to 1 in 133).[13-16] However, despite showing consistent risk reduction from exercise-based prevention programs since 2008, ACL injury rates have not decreased.[17-20] The continued high incidence may be due to the lack of implementation of ACL injury prevention training, which in part may be due to limited knowledge on who should receive this training and when it should be implemented.[21] Identifying high-risk cohorts not only helps to direct injury prevention efforts toward those most in need, but also informs research priorities, refines program design, fosters stakeholder buy-in, and supports advocacy for the broader adoption of targeted, evidence-based interventions.[22] Certain athlete demographic characteristics have been associated with increased ACL injury risk such as age, sport, or sex. Many studies and meta-analyses have shown that overall, females have a greater risk for sustaining an ACL injury compared to males.[22,23] Some groups are advocating for universal ACL injury prevention training, but the rationale for extensive resources applied to athletes that may not be at high risk could cause confusion and be an inappropriate use of resources.[24] Thus, knowing which groups would most benefit from allocated prevention efforts would improve risk reduction system effectiveness.

Previous meta-analyses and studies have revealed substantial variability in overall rate estimates of ACL injury without determining the sources of this variability.[22,23] In addition, some studies[22] lacked an understandable rate reporting estimation, using athlete exposures (AEs) for their analysis, which may influence risk understanding and therefore motivation to implement prevention resources. For example, while AEs are considered the gold standard in sports injury epidemiology, they cannot be easily translated into base rates that are typically seen by practitioners or the public such as injury rate per season played. Lastly, it is not known whether there is incidence data missing or where more observational studies need to be conducted to determine precise injury rates. To fill these research gaps, the primary purpose of this study was to estimate the risk of primary ACL injury across sport, competition level, and sex using more interpretable season-based metrics (injuries per athlete-year). The secondary purpose was to address the substantial variability in reported injury rates and identify missing incidence data.

METHODS

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[25] when conducting this systematic review and meta- analysis.

Eligibility Criteria

We performed a literature search with the electronic databases of PubMed and EBS-Cohost (CINAHL Plus and MEDLINE) on April 20, 2021, March 1, 2022, and updated again on March 19, 2025 to include more recent data. For these searches, we used a keyword search with a combination of keywords involving Anterior Cruciate Ligament Injuries AND Epidemiology OR Incidence OR Prevalence AND tear OR rupture. We limited our search to articles published in the English language where all participants were humans and exported publication details from all studies identified as eligible to bibliographic software (Endnote X9; Clarivate Analytics, Philadelphia, PA).

Data Inclusion Criteria

A single author performed the initial screening of articles from April 2021 & March 2022 searches for inclusion, while a second helped with the secondary screening/inclusion. Two additional authors performed the initial screening and secondary screening/inclusion of articles from the March 2025 search. We first screened the articles by title, next by abstract, and then by reading the full text of the study to assess for the inclusion and exclusion criteria. We applied the following inclusion criteria: (1) Research conducted in athletes playing in organized sports, (2) Total number of ACL injuries (both non-contact and contact in nature) and total number of individuals (non-injured) in the population were recorded. Studies were excluded if: (1) secondary ACL injury was detailed, (2) total population was not identified, (3) mentioned strictly ACL reconstruction, not denoting ACL injuries, (4) multi-sport athletes, (5) no differentiation between male and female athletes, and (6) recreational or youth level sports were indicated and (7) 0 ACL injuries were noted. In instances when multiple studies used the exact same dataset, we included the most recently published study. In instances when multiple studies used the same database or dataset, we included the study with the most cases. During review, we discussed any discrepancies regarding inclusion of an article and resolved them with a second author. During the literature search, we cross-referenced when studies that met inclusion criteria cited other studies.

Data Extraction and Analysis

We analyzed each article for the following information: year of publication, type of study, the studies observational time-period, the number of ACL injuries, type of sport, participation level, sex, and total participants. Due to sports being played outside the United States, some levels were hard to establish as uniform. Thus, we grouped semi-professional and collegiate teams together and labeled them as collegiate, except for women's semi-professional handball, where both included studies examined European handball at the semi-professional level.[21,25]

The reported person-time unit was not uniform across studies. To establish a more easily understood metric of comparison we calculated the ACL injury rate by taking the total number of ACL injuries over a study period and dividing it by athlete-years. We calculated athlete-years as the product of total study participants multiplied by the number of exposure years, with each year being approximately one season. For studies with a period of 1-3 years, we used the study duration as the number of exposure years. For studies of 4 years or longer, we used 4 years as the exposure length because we estimated the average athlete's career length was 4 years. This metric describes an individual athlete's probability of suffering an ACL tear per season played.

For studies in which the number of ACL injuries could not be established, or total participation was not listed, we emailed authors to gather that data. Total population refers to the number of individuals included in each study cohort for which injury rates were reported. We excluded studies if the total population could not be identified or reasonably estimated. When participant numbers were not explicitly reported but sufficient contextual information was available (e.g., number of teams, average roster size, or competition details), we derived population estimates using established metrics, such as average team roster sizes for the given sport and competition level. We used these estimates to ensure consistency and comparability across studies. We discussed and resolved any discrepancies between classifications or values between the authors.

Risk of Bias Assessment

We conducted risk of bias assessments using the Joanna Briggs Institute Critical Appraisal tool for use in JBI Systematic Reviews.[26] This tool assessed characteristics, such as if the participants were recruited in an appropriate way, if the sample size was adequate, were there valid, and standard methods for all subjects, and if there was appropriate statistical analysis. For each study, we answered each item on the checklist with either a “yes”, “no”, “unclear” or “not applicable”. The full checklist can be seen in Table 1. Out of a checklist of nine items, we gave an overall appraisal of the studies on whether to include them in our analysis or not. If criteria were met, and an item was labeled with a “yes” it was scored as 1. If criteria were not met, and an item was labeled with an “unclear” or “no” it was scored as a 0. The maximum score possible was 9. We discussed and resolved any discrepancies in scoring. If the studies received a total score of 8 and above, we gave them a high-quality rating (low risk of bias). If the studies received a total score of 7 out of 9, we gave them a moderate quality rating (moderate risk of bias). If the studies received a total score of 6 out of 9, we gave them a moderate/low quality rating (moderate-to-high risk of bias). If the studies received a total score of less than or equal to 5, we deemed them to be of low quality (high risk of bias).

Using the checklist described above proved to be difficult for some studies. As such, we modified and added to our criteria for specific questions. For question 3 when it asked if the sample size was adequate, we added a clause that if a study had equal to or greater than 10 ACL injuries, or events, then the sample size was deemed sufficient.[24] This was then labeled with a “yes”. If a study particularly examined intervention techniques, we based our numbers only on the control group, and not each intervention group. Another question we had to pay close attention to was question 9, which asked if the response rate of the study was adequate, and if not, was the low response rate managed appropriately? Many of the studies did not provide a response rate, and when they did, it was hard to normalize what was deemed sufficient. If they did not provide a response rate, we gave them the title, “unclear”. When information was given about the rate of response, we decided that no more than 30% dropout (or 70% response rate) was considered adequate and could be labeled with a “yes”. In addition, we could not complete the risk of bias assessments for published abstracts of poster presentations, and we noted them as “NA” (non-applicable) in Table 1.

Statistical Analysis

The primary outcome of interest for the analysis of our data was the ACL injury rate (IR). We used both univariate subgroup and meta-analysis techniques. Specifically, we used a random-effects model (using restricted maximum likelihood estimators) to calculate the incidence rates per season and statistical parameters such as 95% Confidence Intervals (CI) for the various sport characteristics. For studies with zero cell counts in the numerator (ACL injuries) we used 0.5 as the continuity correction. For univariate comparisons, we included only the subgroups defining the sport across each competition level and sex, with at least two studies in the analysis. We performed all statistical analyses and calculations with the packages metafor[27] and meta[28] with the statistical software environment R (RStudio Version, 1.4.1103, the R Foundation for Statistical Computing).

RESULTS

We performed the electronic literature search on April 20, 2021, and again on March 1, 2022, yielding 7543 studies for initial review. 7485 were specifically flagged from the PubMed database, and 58 studies from the Montalvo et al[22] meta-analysis were included in the total number of 7543 studies. In the initial two searches, we removed records before screening if the species were not human (n=1168) or not recorded in English (n=280), leaving a total of 6095 studies. We updated the electronic search on March 19, 2025, and yielded an additional 1926 studies for review, resulting in a final total of 8021 studies being screened. In the updated search, we removed studies not recorded in English or examining non-human species during the title and abstract screening. Additionally, we screened titles and abstracts for mentions of specific keywords and excluded 5334 studies for lack of relevance to our research, and 88 studies could not be found or retrieved, leaving us with 2599 remaining studies. Next, our inclusion and exclusion criteria were applied, which removed 2373 studies, leaving a new total of 226 studies. The remaining 226 studies were manually cross-referenced, and we contacted the corresponding authors as needed for relevant data, leading to the exclusion of 137 more studies. The reason for these exclusions were multi-sport athletes or not delineating between male and female sexes. At the end of the search, we included a total of 89 studies in our meta-analysis. A flowchart of the literature screening process and review is presented in Figure 1.

Figure 1 here

Risk of Bias Assessment

Our results of the risk of bias assessment included 38 studies out of 89 total studies that received a score of 9 out of 9 points for a proportion of 43% (Table 1). We had 35 studies out of a total of 89 which a score of 8 out of 9 points for a proportion of 39%. We gave 13 studies out of a total of 89 studies a score of 7 out of 9 points for a proportion of 15%. We had 2 studies out of a total of 89 studies that had a score of 6 out of 9 points for a proportion of 2%. Lastly, 1 out of the 89 studies (1%) was a published abstract from a poster presentation so we could not conduct a risk of bias assessment, and we noted this as “NA” in Table 1.

Table 1 here

Results by Sport Type/Level/Sex

Figure 2 shows an overview of the data for the combined meta-analytic ACL injury rate in male and female sports, across each level for subgroups that included more than one data entry (e.g., k>1). The data entries included in each of the group rate estimates are included in Table 2. The sport type/level/sex that had the greatest number of entries included were female and male professional soccer (k=18; k=15 entries respectively), female high school soccer (k=12 entries), and female collegiate soccer (k=8 entries). The top 3 sports with the most amount of ACL injuries were (1) male collegiate soccer, with 2037 ACL injuries, (2) male professional soccer, with 1643 ACL injuries, (3) female collegiate basketball, with 1121 ACL injuries and (See Figure 3). The highest risk sports were female semi-professional handball (IR = 0.045, 95% CI [0.025, 0.080]), female professional basketball (IR = 0.027, 95% CI [0.0084, 0.081]), and female professional alpine skiing (IR = 0.025, 95% CI [0.0030, 0.18]) (See Figure 2).
Substantial gaps in injury data were found (See Figure 3), and most notably can be seen where the values are identified as “NA”. This means that there wasn’t any data specifying ACL injuries within a certain sex and sport, across a particular level.

Figure 2 here

Table 2 here

Figure 3 here

DISCUSSION

Our findings highlight the sports/levels with the highest risk of ACL injuries. Female semi-professional handball had the highest risk (IR = 0.045, 95% CI [0.025, 0.080]), followed by female professional basketball (IR = 0.027, 95% CI [0.0084, 0.081]), and female professional alpine skiing (IR = 0.025, 95% CI [0.0030, 0.18]) (Figure 2). These results emphasize the need to prioritize prevention efforts in sports with the greatest relative injury risk.

As mentioned in the methods section of this paper, there were various studies that included sports with 0 ACL injuries. Due to this, we could not use them in our combined analysis because it was not a reliable estimate. Therefore, more data is needed due to the insufficient number of studies and low sample size of the event (i.e., ACL injuries). These studies included sports like ballet, dance, field & ice hockey, floorball, gymnastics, netball, and wrestling. More research and future studies need to account for and observe these groups to get a more accurate estimation of risk in these sport populations.

The more popular sports usually gather information from surveillance systems (e.g., High School Rio, NCAA Injury Surveillance System, etc.) However, there is little data for some other popular sports, such as baseball/softball, handball, rugby, tennis, and snowboarding. Thus, future studies should focus on including more data for underrepresented sports, in addition to collecting more surveillance data for the less common subgroups.

Some of the most robust epidemiological data is captured through surveillance systems such as the National Football League (NFL) Surveillance Database, the High School Reporting Information Online (RIO), and the National Collegiate Athletic Association (NCAA)

Surveillance Database. However, to capture more diverse sport data, efforts should be made to develop a global database with rigorous methods. For example, researchers can replicate what the International Olympic Committee (IOC) injury surveillance does, but on a seasonal level and not just for individual events.

It is worth noting that most of the studies we looked at were of high or moderate quality (82% and 15%, respectively) while only 2% were of low quality. Therefore, the majority of the articles were of low bias and can therefore be considered robust indicators for incidence estimation. However, one part of the risk of bias assessment was adequate sample size and 25 of 89 included studies (28%) had less than 10 ACL injuries per subgroup, which denotes the need for larger studies to be conducted.

This research highlights important facts about the risk of ACL injuries within various sports. Risk is highly dependent on the type of sport that is played, level, and sex. Although females are at an increased risk for ACL injury, investigators should be cautious when grouping or overgeneralizing sex-specific injury risk because the type of sport and level also needs to be considered. For example, our results showed male professional football athletes (IR=0.024 injuries/athlete-year) are almost 3 times more likely to tear their ACL compared to female collegiate basketball athletes (IR=0.0084 injuries/athlete-year) over the course of a season.

In previous literature, it is seen that neuromuscular training is most effective at reducing ACL injury risk at a younger age (14-18).[13,119] However, we found injury risk was highest for semi-professional and professional athletes. This is particularly interesting because professional sports have more access to resources and training programs compared to youth or high school level sports. Future research may investigate developing more effective prevention programs for professional athletes to decrease injury rates.

Due to the nature of such a large meta-analysis, with 89 studies included, there are potential limitations to consider. First, due to a wide range of inclusion and exclusion criteria, there were numerous articles to assess. As such, there is always a possibility of not capturing all relevant manuscripts within our search criteria as well as data that is unpublished. Also, not all articles reported the rate of ACL injuries in the same format, which prevented our ability to directly aggregate. Second, within the methods of this analysis, each study used various methods to ascertain the data for ACL injuries and as such can impact the observed and reported rate of them. In addition, typically more reviewers are included to reduce bias and increase the number of relevant studies. We included a second reviewer in the screening process of the initial two searches, but only after the initial searches were conducted. We had two different reviewers conduct the screening, inclusion, and data extraction of the final updated search.

Calculations and other assumptions had to be made which could lead to bias. We reviewed many articles to find specific inclusion and exclusion criteria, namely the total number of participants. Not all studies reported this information, and thus, we had to calculate total participants based upon the average roster size for a specific subgroup of a sport. Given the calculations and other assumptions that had to be made, there may be added variation and bias.

Next, there were limited studies showing “youth” or “recreational” (i.e. grade school) ACL injuries. They typically occur in middle and/or high school and thus were hard to pinpoint, suggesting a limitation of this study and something that needs to be examined in further research. While our study included high school athletes, typically aged 14 to 18, as part of the analysis, we were unable to include youth or recreational athletes due to the limited availability of systematically reported data in these populations. Future research should aim to address these gaps to provide a more comprehensive understanding of ACL injury risk across all levels of sport participation.

Another limitation of this study is the inability to account for multisport athletes, as the included studies did not specify whether participants engaged in multiple sports. However, at higher levels of competition, it is more likely that athletes specialize in a single sport, minimizing the potential impact of this issue on our estimates. Theoretically, the risks from participating in multiple sports could be additive, potentially increasing overall exposure and injury risk. Future research should aim to differentiate between single-sport and multisport athletes to better understand how varying exposures influence ACL injury risk.

Conclusion

This systematic review and meta-analysis exposed substantial variability in injury rates within sport levels and across sports and sexes. In general, the highest injury rates occurred in professional sports, warranting the need for better targeted risk reduction initiatives within this group. In most of the populations, female athletes demonstrated the greater risk of ACL injury compared to male athletes. However, due to the gaps in data and sport preference differences between genders, this assumption cannot be applied to every sport or level. Investigators and practitioners should be cautious about overgeneralization of sex and sport differences in ACL injury risk without the consideration of other intrinsic factors associated with the specific sport and participation. Future studies should aim to have a more complete coverage of sports at all levels of play to have more data as a means of comparison. When more information is discovered, a group-based risk assessment tool could be developed to allocate resources and prevention training to reduce the number of ACL injuries.

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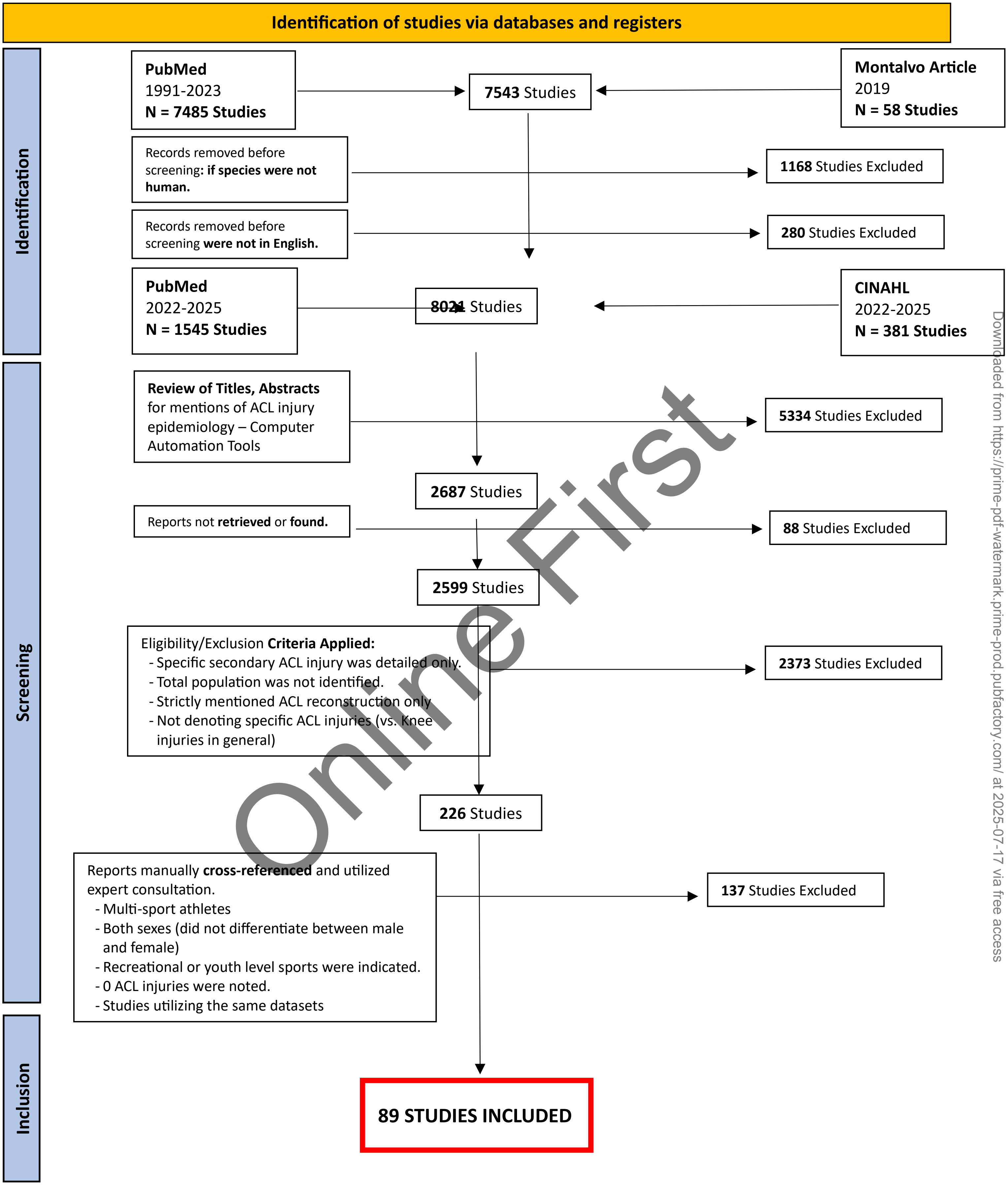
Identification of studies via databases and registers
Identification
Screening
Inclusion
PubMed
1991-2023
N = 7485 Studies
7543 Studies
Montalvo Article
2019
N = 58 Studies
Records removed before screening: if species were not human.
1168 Studies Excluded
Records removed before screening were not in English.
280 Studies Excluded
PubMed
2022-2025
N = 1545 Studies
8021 Studies
CINAHL
2022-2025
N = 381 Studies
Review of Titles, Abstracts for mentions of ACL injury epidemiology – Computer Automation Tools
5334 Studies Excluded
2687 Studies
Reports not retrieved or found.
88 Studies Excluded
2599 Studies
Eligibility/Exclusion Criteria Applied:
- Specific secondary ACL injury was detailed only.
- Total population was not identified.
- Strictly mentioned ACL reconstruction only
- Not denoting specific ACL injuries (vs. Knee injuries in general)
2373 Studies Excluded
226 Studies
Reports manually cross-referenced and utilized expert consultation.
- Multi-sport athletes
- Both sexes (did not differentiate between male and female)
- Recreational or youth level sports were indicated.
- 0 ACL injuries were noted.
- Studies utilizing the same datasets
137 Studies Excluded
89 STUDIES INCLUDED

Table 1. Results/Scores of the risk of bias assessment

Study (y)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Amundsen et al 2023[29]	Yes	Yes	No	Yes	Yes	Yes	Unclear	Yes	Yes	7
Astur et al 2023[30]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Awwad et al 2019[31]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Bennett et al 2024[32]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Beynnon et al 2014[33]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Bezuglov et al 2024[34]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Bjorneboe et al 2010[35]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Bloch et al 2023[36]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Bonato et al 2018[37]	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	8
Bradley et al 2002[38]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Brooks et al 2005[39] (Part 1)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Brooks et al 2005[40] (Part 2)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Caraffa et al 1996[41]	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	No	Unclear	6
Dallalana et al 2007[42]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Deitch et al 2006[43]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
DeLee et al 1992[44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
denHollander et al 2024[45]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Devetag et al 2018[46]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	8
Dodson et al 2016[47]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Dragoo et al 2012[48]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	8

Faude et al 2005[49]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Gilchrist et al 2008[50]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Giza et al 2005[51]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Grassi et al 2020[52]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Gupta et al 2020[53]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Haida et al 2016[54]	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	7
Hagglund et al 2013[55]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Hagglund et al 2009[56]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Heidt et al 2000[57]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Hewett et al 1999[58]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Howard et al 2016[59]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Joseph et al 2013[60]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
LaBella et al 2011[61]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Lambson et al 1996[62]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
LaPrade and Burnett 1994[63]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Larruskain et al 2018[64]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Le Gall et al 2008[65]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Levy et al 1997[66]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Liederbach et al 2008[67]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Lombardo et al 2005[68]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Longstaffe et al 2020[11]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Mandelbaum et al 2005[69]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Messina et al 1999[70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9

Meyers et al 2004[71]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Meyers et al 2010[72]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Meyers et al 2013[73]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Mihata et al 2006[74]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Myer et al 2015[75]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Myklebust et al 2003[5] (Year 1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Nagano et al 2011[76] (Year 4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nilstad et al 2014[77]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Omi et al 2018[78]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Oshima et al 2018[79]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Ostenberg and Roos 2000[80]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Padua et al 2015[81]	Yes	Unclear	No	Yes	Yes	Yes	Yes	Yes	Yes	7
Palmieri-Smith et al 2021[82]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Pasanen et al 2018[83]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Pasanen et al 2008[84]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Petersen et al 2005[21]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Petushek et al 2021[85]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Pujol et al 2007[86]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Quisquater et al 2013[87]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Raschner et al 2012[88]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Rekik et al 2018[89]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8

Rochcongar et al 2009[90]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Roi et al 2006[91]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Roos et al 1995[92]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Schiffner et al 2018[93]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Scranton et al 1997[94]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Seil et al 1998[95]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclear	7
Silvers-Granelli et al 2017[96]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Singh et al 2013[97]	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	6
Soderman et al 2000[98]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	7
Soderman et al 2001[99]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Stanley et al 2016[100]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Steffen et al 2008[101]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Szymski et al 2021[102]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Takazawa et al 2016[103]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Taketomi et al 2024 A[104]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Taketomi et al 2024 B[105]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	8
Tegnander et al 2008[106]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Trojian et al 2006[107]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Viola et al 1999[108]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Vauhnik et al 2011[109]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Walden et al 2011[110]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Unclear	7
Walden et al 2012[111]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Wedderkopp et al 1997[112]	Yes	Yes	Yes	Yes	Yes	Unclea	Yes	Yes	Yes	8

						r				
Westin et al 2020[113]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Zebis et al 2022[114]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Unclea r	7

Figure 2: Forest plot for the combined injury risk of anterior cruciate ligament injury in male and female sports, across each level. Error bars represent the 95% confidence intervals (CI's).

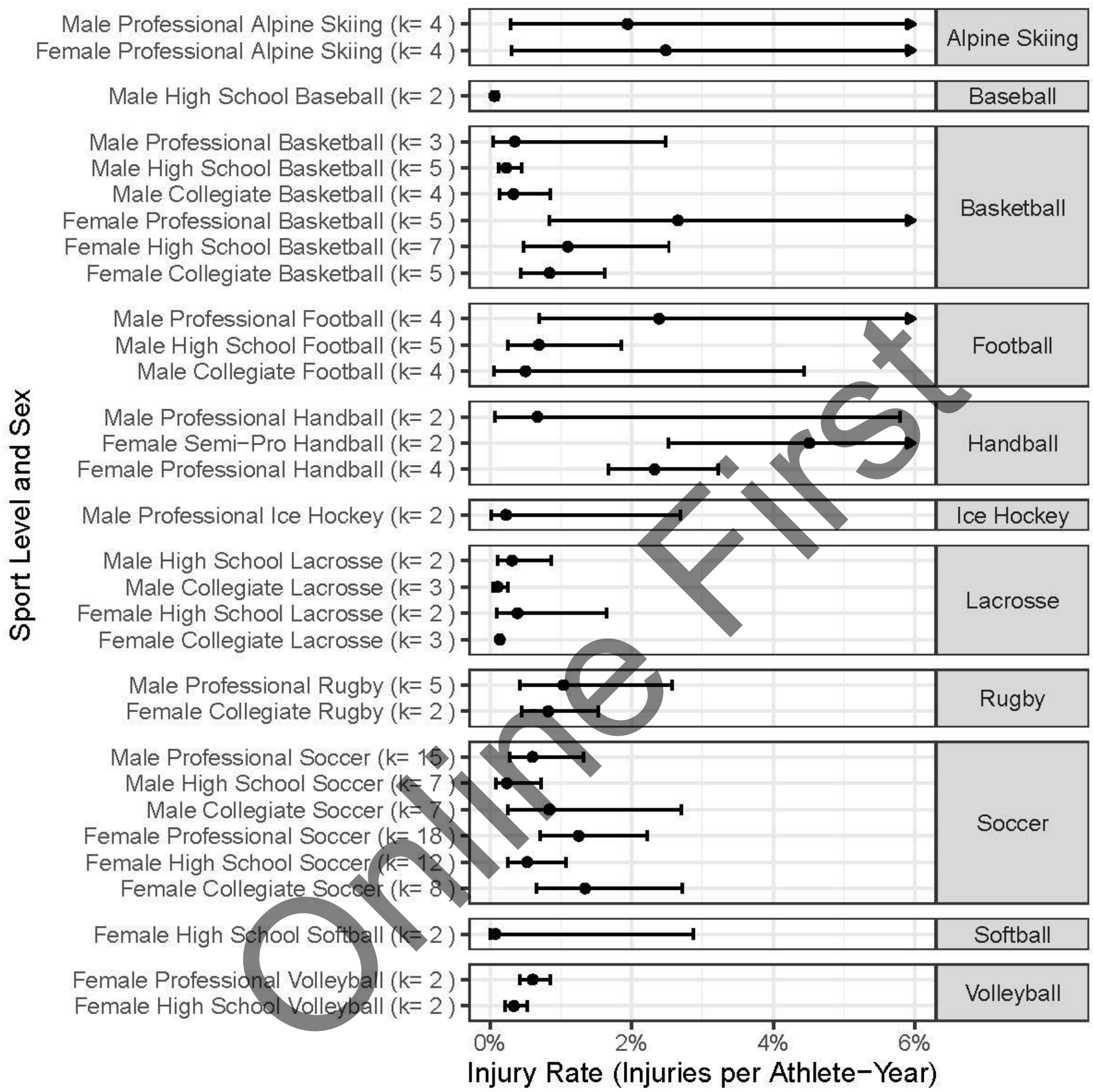

Table 2. Data extracted for all studies based on sport type, level, and sex

Sport Type	Level/Division	Study Type	Author(s) and Year	Total Number of ACL Injuries	Athlete Years	Injury Rate	95% Confidence Interval (Lbound)	95% Confidence Interval (Ubound)	Risk of Bias
Alpine Skiing	High School		Female						
		Intervention	Westin et al 2020[113]	4	576	0.0069	0.0026	0.018	9
			Male						
		Intervention	Westin et al 2020[113]	11	844	0.013	0.0072	0.023	9
	Professional		Female						
		Observational	Haida et al 2016[54]	81	952	0.085	0.069	0.10	7
		Observational	Pujol et al 2007[86]	53	752	0.070	0.054	0.091	8
		Observational	Raschner et al 2012[88]	39	700	0.056	0.041	0.075	8
		Observational	Viola et al 1999[108]	10	10472	0.00095	0.00051	0.0018	9
			Combined Rate	**183**	**12876**	**0.025**	**0.0030**	**0.16**	
			Male						
		Observational	Haida et al 2016[54]	67	956	0.070	0.056	0.088	7
		Observational	Pujol et al 2007[86]	52	764	0.068	0.052	0.088	8

		Observational	Raschner et al 2012[88]	18	780	0.023	0.015	0.036	8
		Observational	Viola et al 1999[108]	21	18148	0.0012	0.00075	0.0018	9
			Combined Rate	**158**	**20648**	**0.019**	**0.0029**	**0.12**	
Australian Rules Football	Professional		Female						
		Observational	Bennett et al 2024[32]	**11**	**424**	**0.026**	**0.014**	**0.046**	9
Ballet	Professional		Female						
		Observational	Liederbach et al 2008[67]	**2**	**256**	**0.0078**	**0.0020**	**0.031**	9
			Male						
		Observational	Liederbach et al 2008[67]	**1**	**212**	**0.0047**	**0.00066**	**0.033**	9
Basketball	High School		Female						
		Observational	Beynnon et al 2014[33]	6	3900	0.0015	0.00069	0.0034	9
		Intervention	Hewett et al 1999[115]	3	189	0.016	0.0051	0.048	8
		Observational	Joseph et al 2013[60]	92	6000	0.015	0.015	0.019	8
		Observational	Messina et al 1999[70]	11	890	0.012	0.0069	0.022	9
		Observational	Myer et al 2015[75]	9	240	0.038	0.020	0.070	7
		Observational	Oshima et al 2018[79]	15	516	0.029	0.018	0.048	9
		Observational	Stanley et al 2016[100]	35	9660	0.0036	0.0026	0.0050	8
			Combined Rate	**171**	**21395**	**0.011**	**0.0047**	**0.025**	
			Male						

		Observational	Beynnon et al 2014[33]	4	3900	0.0010	0.00038	0.0027	9
		Intervention	Hewett et al 1999[115]	0	225	0.0022	0.00014	0.034	8
		Observational	Joseph et al 2013[60]	25	6000	0.0041	0.0028	0.0062	8
		Observational	Messina et al 1999[70]	4	973	0.0041	0.0015	0.011	9
		Observational	Stanley et al 2016[100]	12	8640	0.0014	0.00079	0.0024	8
			Combined Rate	**45**	**19738**	**0.0023**	**0.0012**	**0.0044**	

Basketball	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	5	1440	0.0035	0.0014	0.0063	9
		Observational	LaPrade and Burnett 1994[63]	1	20	0.050	0.0070	0.28	7
		Observational	Mihata et al 2006[74]	1061	91800	0.012	0.011	0.012	9
		Observational	Omi et al 2018[78]	16	1236	0.013	0.0079	0.021	9
		Observational	Stanley et al 2016[100]	38	8640	0.0044	0.0032	0.0060	8
			Combined Rate	**1121**	**103136**	**0.0084**	**0.0044**	**0.016**	
			Male						
		Observational	Beynnon et al 2014[33]	2	1440	0.0014	0.00035	0.0055	9
		Observational	LaPrade and Burnett 1994[63]	1	30	0.033	0.0047	0.20	7
		Observational	Mihata et al 2006[74]	332	89280	0.0037	0.0033	0.0041	9

		Observational	Stanley et al 2016[100]	15	7980	0.0019	0.0011	0.0031	8
			Combined Rate	**350**	**98730**	**0.0033**	**0.0013**	**0.0085**	
	Professional		Female						
		Intervention	Bonato et al 2018[37]	7	74	0.095	0.046	0.185	8
		Observational	Deitch et al 2006[43]	14	1772	0.0079	0.0047	0.013	9
		Intervention	Nagano et al 2011 (Year 1)[76]	7	158	0.044	0.021	0.090	N/a
		Observational	Trojian et al 2006[107]	9	1484	0.0061	0.0032	0.012	8
		Observational	Vauhnik et al 2011[109]	3	41	0.073	0.024	0.20	9
			Combined Rate	**40**	**3529**	**0.027**	**0.0084**	**0.081**	
			Male						
		Observational	Bloch et al 2023[36]	14	30068	0.00047	0.00028	0.00079	9
		Observational	Deitch et al 2006[43]	22	2808	0.0078	0.0052	0.012	9
		Observational	Lombardo et al 2005[68]	14	1220	0.011	0.0068	0.019	9
			Combined Rate	**50**	**34096**	**0.0035**	**0.00048**	**0.025**	
Dance	Professional		Female						
		Observational	Liederbach et al 2008[67]	**8**	**476**	**0.017**	**0.0084**	**0.033**	9
			Male						
		Observational	Liederbach et al 2008[67]	**1**	**248**	**0.0040**	**0.00057**	**0.028**	9
	High School		Female						

Field Hockey		Observational	Beynnon et al 2014[33]	**4**	**1760**	**0.0023**	**0.00085**	**0.0060**	9
	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	**1**	**528**	**0.0019**	**0.00027**	**0.013**	9
Floorball	High School		Female						
		Observational	Pasanen et al 2018[83]	**8**	**225**	**0.036**	**0.018**	**0.069**	8
			Male						
		Observational	Pasanen et al 2018[83]	**0**	**333**	**0.0015**	**.000094**	**0.023**	8
	Professional		Female						
		Observational	Pasanen et al 2008[84]	**3**	**201**	**0.015**	**0.0048**	**0.045**	9

Football	High School		Male						
		Observational	Beynnon et al 2014[33]	8	6800	0.0012	0.00059	0.0024	9
		Observational	DeLee et al 1992[44]	37	4399	0.0084	0.0061	0.012	9
		Observational	Joseph et al 2013[60]	286	20000	0.014	0.013	0.016	8
		Observational	Lambson et al 1996[62]	42	9957	0.0042	0.0031	0.0057	9
		Observational	Meyers et al 2004[71]	15	640	0.023	0.014	0.039	8
			Combined Rate	**388**	**41796**	**0.0069**	**0.0026**	**0.019**	
	Collegiate		Male						
		Observational	Beynnon et al 2014[33]	3	780	0.0038	0.0012	0.012	9
		Observational	Dragoo et al 2012[48]	318	1251768	0.00025	0.00023	0.00028	8
		Observational	Meyers et al 2010[72]	52	3456	0.015	0.011	0.020	9
		Observational	Taketomi et al 2024 A[104]	13	308	0.042	0.025	0.071	8
			Combined Rate	**386**	**1256312**	**0.0050**	**0.00055**	**0.044**	
	Professional		Male						
		Observational	Bradley et al 2002[38]	209	5704	0.037	0.032	0.042	9
		Observational	Dodson et al 2016[47]	219	2416	0.091	0.080	0.10	9
		Observational	Palmieri-Smith et al 2021[82]	314	65612	0.0048	0.0043	0.0053	9
		Observational	Scranton et al 1997[94]	78	4048	0.019	0.015	0.024	9
			Combined Rate	**820**	**77780**	**0.024**	**0.0070**	**0.079**	

			Female						
Gymnastics	Collegiate	Observational	LaPrade and Burnett 1994[63]	**0**	**12**	**0.042**	**0.0026**	**0.42**	7
			Male						
		Observational	LaPrade and Burnett 1994[63]	**0**	**16**	**0.031**	**0.0019**	**0.35**	7
Handball	High School		Female						
		Observational	Oshima et al 2018[79]	**12**	**312**	**0.038**	**0.022**	**0.066**	9
	Semi-Professional		Female						
		Intervention	Petersen et al 2005[21]	5	142	0.035	0.015	0.082	8
		Observational	Zebis et al 2022[114]	6	108	0.056	0.025	0.12	7
			Combined Rate	**11**	**250**	**0.045**	**0.025**	**0.080**	
	Professional		Female						
		Intervention	Myklebust et al 2003[5] (Year 1)	29	942	0.031	0.021	0.044	9
		Observational	Petushek et al 2021[85] (contact & noncontact)	32	1716	0.019	0.013	0.026	8
		Observational	Vauhnik et al 2011[109]	6	258	0.023	0.010	0.051	8
		Observational	Wedderkopp et al 1997[112]	4	209	0.019	0.0072	0.050	8
			Combined Rate	**71**	**4841**	**0.023**	**0.017**	**0.032**	
			Male						
		Observational	Bloch et al 2023[36]	69	30068	0.0023	0.0018	0.0029	9
		Observational	Seil et al 1998[95]	4	186	0.022	0.0061	0.056	7
			Combined Rate	**73**	**30254**	**0.0067**	**0.00074**	**0.058**	
Ice Hockey	Collegiate		Female						

		Observational	Stanley et al 2016[100]	**5**	**4080**	**0.0012**	**0.00051**	**0.0029**	8
			Male						
		Observational	Stanley et al 2016[100]	**17**	**8480**	**0.0020**	**0.0012**	**0.0032**	8
	Professional		Male						
		Observational	Bloch et al 2023[36]	19	30068	0.00063	0.00040	0.0010	9
		Observational	Longstaffe et al 2020[11]	67	8352	0.0080	0.0063	0.010	9
			Combined Rate	**86**	**38420**	**0.0023**	**0.00019**	**0.027**	

Lacrosse	High School		Female						
		Observational	Beynnon et al 2014[33]	6	3384	0.0018	0.00080	0.0039	9
		Observational	Stanley et al 2016[100]	32	4104	0.0078	0.0055	0.011	8
			Combined Rate	**38**	**7488**	**0.0039**	**0.00091**	**0.016**	
			Male						
		Observational	Beynnon et al 2014[33]	7	3960	0.0018	0.00084	0.0037	9
		Observational	Stanley et al 2016[100]	22	4392	0.0050	0.0033	0.0076	8
			Combined Rate	**29**	**3960**	**0.0031**	**0.0011**	**0.0086**	
	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	4	3840	0.0010	0.00039	0.0028	9
		Observational	Mihata et al 2006[74]	146	105984	0.0014	0.0012	0.0016	9
		Observational	Stanley et al 2016 [100]	15	9984	0.0015	0.0091	0.0025	8

			Combined Rate	**165**	**119808**	**0.0014**	**0.0012**	**0.0016**	
			Male						
		Observational	Beynnon et al 2014[33]	6	4800	0.0013	0.00056	0.0028	9
		Observational	Mihata et al 2006[74]	169	86976	0.0019	0.0017	0.0023	9
		Observational	Stanley et al 2016[100]	12	24192	0.00050	0.00028	0.00087	8
			Combined Rate	**187**	**115968**	**0.0011**	**0.00048**	**0.0025**	
Netball	Professional		Female						
		Observational	Singh et al 2013[97]	**4**	**236**	**0.017**	**0.0064**	**0.044**	6
Soccer	High School		Female						
		Observational	Beynnon et al 2014[33]	15	2552	0.0059	0.0035	0.0097	9
		Observational	Gupta et al 2020[53]	201	429768	0.00047	0.00040	0.00054	9
		Intervention	Hagglund et al 2013[55]	14	2085	0.0067	0.0040	0.011	9
		Intervention	Heidt et al 2000[57]	8	258	0.031	0.016	0.061	7
		Intervention	Hewett et al 1999[115]	2	193	0.010	0.0026	0.040	8
		Observational	Joseph et al 2013[60]	96	8000	0.012	0.010	0.015	8
		Intervention	LaBella et al 2011[61]	6	755	0.0079	0.0036	0.018	8
		Intervention	Mandelbaum et al 2005[69]	67	7636	0.0088	0.0069	0.011	9
		Observational	Quisquater et al 2013[87]	34	70839	0.00049	0.00035	0.00068	8
		Observational	Stanley et al 2016[100]	31	4444	0.0070	0.0049	0.010	8
		Intervention	Steffen et al 2008[101]	5	947	0.0053	0.0022	0.013	8

		Intervention	Walden et al 2012[111]	14	2085	0.0067	0.0040	0.011	9
			Combined Rate	**493**	**529562**	**0.0052**	**0.0026**	**0.011**	
			Male						
		Observational	Astur et al 2023[30]	160	8499	0.019	0.016	0.022	9
		Observational	Beynnon et al 2014[33]	3	2596	0.0012	0.00037	0.0036	9
		Observational	Gupta et al 2020[53]	76	162848	0.00047	0.00037	0.00058	9
		Intervention	Hewett et al 1999[115]	1	209	0.0048	0.00067	0.0033	8
		Observational	Joseph et al 2013[60]	44	8000	0.0055	0.0041	0.0074	8
		Observational	Quisquater et al 2013[87]	552	1345935	0.00041	0.00038	0.00045	8
		Observational	Stanley et al 2016[100]	19	4488	0.0042	0.0027	0.0066	8
			Combined Rate	**855**	**1532575**	**0.0024**	**0.00078**	**0.0072**	

Soccer	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	11	2356	0.0047	0.0026	0.0084	9
		Intervention	Gilchrist et al 2008[50]	10	852	0.012	0.0063	0.022	9
		Observational	Howard et al 2016[59]	80	1568	0.051	0.041	0.063	9
		Observational	Meyers et al 2013[73]	22	1456	0.015	0.010	0.023	9
		Observational	Mihata et al 2006 [74]	871	115808	0.0075	0.0070	0.0080	9
		Observational	Stanley et al 2016 [100]	55	16864	0.0033	0.0025	0.0042	8
		Observational	Taketomi et al 2024 B[105]	13	435	0.030	0.017	0.051	8
		Observational	Zebis et al 2022[114]	3	72	0.042	0.014	0.12	7
			Combined Rate	**1065**	**139411**	**0.013**	**0.0066**	**0.027**	
			Male						
		Observational	Agel et al 2005[17]	192	181412	0.0011	0.00092	0.0012	8
		Observational	Arendt et al 1999[116]	81	35036	0.0023	0.0019	0.0029	8
		Observational	Astur et al 2023[30]	165	4379	0.038	0.032	0.044	9
		Observational	Beynnon et al 2014[33]	6	2232	0.0027	0.0012	0.0060	9
		Intervention	Caraffa et al 1996[41]	70	900	0.078	0.062	0.097	6
		Observational	Harmon et al 1998[117]	123	87232	0.0014	0.0012	0.0017	9
		Observational	Mihata et al 2006 [74]	424	127252	0.0033	0.0030	0.0037	9
		Intervention	Silvers-Granelli et al 2017[96]	16	850	0.019	0.012	0.031	9
		Observational	Stanley et al 2016 [100]	10	10664	0.00094	0.00050	0.0017	8
		Observational	Szymski et al 2022[102]	950	187092	0.0051	0.0048	0.0054	9
			Combined Rate	**2037**	**822977**	**0.0084**	**0.0026**	**0.027**	

			Female						
		Observational	Amundsen et al 2023[29]	8	588	0.014	0.0068	0.027	7
		Observational	Den Hollander et al 2024[45]	12	486	0.025	0.014	0.043	8
		Observational	Faude et al 2005[49]	11	143	0.077	0.043	0.13	9
		Observational	Giza et al 2005[51]	8	404	0.020	0.0010	0.039	7
		Observational	Hagglund et al 2009[56]	8	228	0.035	0.018	0.069	9
		Observational	Larruskain et al 2018[64]	6	140	0.043	0.019	0.092	7
		Observational	Le Gall et al 2008[65]	12	960	0.013	0.0071	0.022	9
		Observational	Nilstad et al 2014[77]	5	173	0.029	0.012	0.068	8
		Observational	Ostenberg and Roos 2000[80]	3	123	0.024	0.0079	0.073	8
		Observational	Padua et al 2015[81]	3	1443	0.0021	0.00067	0.0064	7
		Observational	Petushek et al 2021[85] (contact and noncontact)	30	1804	0.017	0.012	0.023	8
		Observational	Quisquater et al 2013[87]	6	12501	0.00049	0.00022	0.0011	8
		Observational	Roos et al 1995[92]	106	36730	0.0029	0.0024	0.0035	9
	Professional	Observational	Soderman et al 2000[98]	1	78	0.013	0.0018	0.085	7
		Intervention	Soderman et al 2001[99]	5	146	0.034	0.014	0.080	8
		Observational	Szymski et al 2022[102]	67	13044	0.0051	0.0040	0.0065	9
		Observational	Tegnander et al 2008[106]	2	181	0.011	0.027	0.043	8
		Observational	Walden et al 2011[118]	9	1240	0.0073	0.0038	0.014	7
			Combined Rate	**302**	**72216**	**0.013**	**0.0070**	**0.022**	

Soccer	Professional		Male						
		Observational	Bezuglov et al 2024[34]	76	1600	0.048	0.038	0.059	8

		Observational	Bjorneboe et al 2010[35]	14	462	0.030	0.018	0.050	8
		Observational	Bloch et al 2023[36]	58	30068	0.0019	0.0015	0.0025	9
		Observational	Grassi et al 2020[52]	84	16496	0.0051	0.0041	0.0063	9
		Observational	Hagglund et al 2009[56]	8	239	0.033	0.017	0.065	9
		Observational	Larruskain et al 2018[64]	2	200	0.01	0.0025	0.039	7
		Observational	Padua et al 2015[81]	1	1044	0.00096	0.00013	0.0068	7
		Observational	Quisquater et al 2013[87]	97	237518	0.00041	0.00033	0.00050	8
		Observational	Rekik et al 2018[89]	37	8972	0.0041	0.0030	0.0057	8
		Observational	Rochcongar et al 2009[90]	699	177464	0.0039	0.0037	0.0042	8
		Observational	Roi et al 2006[91]	50	479	0.10	0.080	0.14	8
		Observational	Roos et al 1995[92]	232	151422	0.0015	0.0013	0.0017	9
		Observational	Schiffner et al 2018[93]	72	18560	0.0039	0.0031	0.0049	8
		Observational	Szymski et al 2022[102]	189	36452	0.0052	0.0045	0.0060	9
		Observational	Walden et al 2011[118]	24	8076	0.0030	0.0020	0.0044	7
			Combined Rate	**1643**	**874980**	**0.0060**	**0.0027**	**0.013**	
Softball and Baseball	High School		Female						
		Observational	Joseph et al 2013[60]	21	4800	0.0044	0.0029	0.0067	8
		Observational	Stanley et al 2016 [100]	1	9440	0.00011	.000015	0.00075	8
			Combined Rate	**22**	**14240**	**0.00077**	**.000020**	**0.029**	
			Male						
		Observational	Joseph et al 2013[60]	6	8000	0.00075	0.00034	0.0017	8
		Observational	Stanley et al 2016 [100]	5	9600	0.00052	0.00022	0.0013	8
			Combined Rate	**11**	**17600**	**0.00064**	**0.00035**	**0.0011**	

	Collegiate		Female						
		Observational	Stanley et al 2016 [100]	**12**	**10400**	**0.0012**	**0.00066**	**0.0020**	8
			Male						
		Observational	Stanley et al 2016 [100]	**2**	**6600**	**0.00030**	**.000076**	**0.0012**	8
Rugby	High School		Male						
		Observational	Takazawa et al 2016[103]	**16**	**1160**	**0.014**	**0.0085**	**0.022**	9
	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	6	480	0.013	0.0056	0.028	9
		Observational	Levy et al 1997[66]	21	3240	0.0065	0.0042	0.010	9
			Combined Rate	**27**	**3720**	**0.0082**	**0.0044**	**0.015**	
			Male						
		Observational	Beynnon et al 2014[33]	**3**	**480**	**0.0063**	**0.0020**	**0.019**	9
	Professional		Male						
		Observational	Awwad et al 2019[31]	3	120	0.025	0.0081	0.075	7
		Observational	Brooks et al 2005[39] (Part 1)	7	1092	0.0064	0.0031	0.013	8
		Observational	Brooks et al 2005[40] (Part 2)	2	1004	0.0020	0.00050	0.0079	8
		Observational	Dallalana et al 2007[42]	9	1092	0.0082	0.0043	0.016	8
		Observational	Takazawa et al 2016[103]	12	376	0.032	0.018	0.055	9
			Combined Rate	**33**	**3684**	**0.010**	**0.0042**	**0.026**	

Volleyball	High School		Female						
		Intervention	Hewett et al 1999[115]	0	81	0.0061	0.00038	0.090	8
		Observational	Joseph et al 2013[60]	20	6000	0.0033	0.0022	0.0052	8
			Combined Rate	**20**	**6081**	**0.0034**	**0.0022**	**0.0052**	
	Collegiate		Female						
		Observational	Beynnon et al 2014[33]	**1**	**180**	**0.0056**	**0.00078**	**0.038**	**9**
	Professional		Female						
		Observational	Devetag et al 2018[46]	34	5952	0.0057	0.0041	0.0080	8
		Observational	Vauhnik et al 2011[109]	3	286	0.010	0.0034	0.032	9
			Combined Rate	**37**	**6238**	**0.0060**	**0.0043**	**0.0085**	
Wrestling	High School		Male						
		Observational	Joseph et al 2013[60]	**27**	**1400**	**0.0019**	**0.0013**	**0.0028**	8

Figure 3: Heat Map denoting number of ACL injuries across Sport, Sex and Level. The cells listed with NA (Not Applicable) indicate that there were no studies found based on the specified demographic.

Number of ACL Injuries

Sport	Sex	Level: High School	Collegiate	Professional
Alpine Skiing	Male	11	NA	158
	Female	4	NA	183
Australian Rules Football	Female	NA	NA	11
Ballet	Male	NA	NA	1
	Female	NA	NA	2
Basketball	Male	45	350	50
	Female	171	1121	40
Dance	Male	NA	NA	1
	Female	NA	NA	8
Field Hockey	Female	4	1	NA
Floorball	Male	0	NA	NA
	Female	8	NA	3
Football	Male	388	386	820
Handball	Male	NA	NA	73
	Female	12	11	71
Ice Hockey	Male	NA	17	86
	Female	NA	5	NA
Lacrosse	Male	29	187	NA
	Female	38	165	NA
Netball	Female	NA	NA	4
Rugby	Male	16	3	33
	Female	NA	27	NA
Soccer	Male	855	2037	1643
	Female	493	1065	302
Softball / Baseball	Male	11	2	NA
	Female	22	12	NA
Volleyball	Female	20	1	37
Wrestling	Male	27	NA	NA