Anterior cruciate ligament injury in elite football: a prospective three-cohort study.

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ANTERIOR CRUCIATE LIGAMENT INJURY IN ELITE FOOTBALL:

A PROSPECTIVE THREE-COHORT STUDY

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ABSTRACT

Anterior cruciate ligament (ACL) injury causes long lay-off time and is often complicated with subsequent new knee injury and osteoarthritis. Female gender is associated with an increased ACL injury risk, but few studies have adjusted for gender-related differences in age although female players are often younger when sustaining their ACL injury.

The objective of this three-cohort study was to describe ACL injury characteristics in teams from the Swedish men's and women's first leagues and from several European men's professional first leagues. Over a varying number of seasons from 2001 to 2009, 57 clubs (2329 players) were followed prospectively and during this period 78 ACL injuries occurred (5 partial). Mean age at ACL injury was lower in women compared to men (20.6 ± 2.2 vs. 25.2 ± 4.5 years, p=0.0002). Using a Cox regression, the female-to-male hazard ratio (HR) was 2.6 (95% CI 1.4 to 4.6) in all three cohorts studied and 2.6 (95% CI 1.3 to 5.3) in the Swedish cohorts; adjusted for age, the HR was reduced to 2.4 (95% CI 1.3 to 4.2) and 2.1 (95% CI 1.0 to 4.2), respectively. Match play was associated with a higher ACL injury risk with a match-to-training ratio of 20.8 (95% CI 12.4 to 34.8) and 45 ACL injuries (58%) occurred due to non-contact mechanisms. Hamstrings grafts were used more often in Sweden than in Europe (67% vs. 34%, p=0.028), and there were no differences in time to return to play after ACL reconstruction between the cohorts or different grafts. In conclusion, this study showed that the ACL injury incidence in female elite footballers was more than doubled compared to their male counterparts, but also that they were significantly younger at ACL injury than males. These findings suggest that future preventive research primarily should address the young female football player.

Key words

ACL, epidemiology, sex, soccer, incidence

INTRODUCTION

Football is the most popular sport worldwide. Unfortunately, football-related knee injuries are common and constitute a serious problem regardless of gender or playing level. The knee injury that probably draws the most attention is the anterior cruciate ligament (ACL) injury. A complete tear usually causes long lay-off from football [40], and may even be career-ending [43]. ACL injury is also associated with an increased risk of new knee injury [14, 48], as well as long-term medical disability such as osteoarthritis [31, 45]. Fortunately, there is growing evidence coming up on how to prevent ACL injury in football [9, 21, 32]. There is, however, limited knowledge about potential risk factors for ACL injury in football and most of the current evidence is actually based on studies from other football codes like American or Australian Rules football [3]. In football, match play is associated with a considerably higher ACL injury risk than training [4-5, 13, 18-20]. Furthermore, female footballers are 2-3 times more susceptible to ACL injury compared to their male counterparts [36, 49]. Finally, a history of previous ACL injury has been associated with a five-fold increased risk of a new ACL injury in women´s elite football [14].

Interestingly, low age at injury seems to be a special concern among female players [8, 41], and the risk seems to be highest during the late pubertal or first post-pubertal years [42]. From a recent review, however, it is concluded that the effect of age on the likelihood of suffering an ACL tear is not well understood and needs to be studied further [37]. The main objective of this prospective three-cohort study on male and female football players was to describe the ACL injury incidence in elite football. The hypothesis was that the ACL injury risk is higher for women, but that an adjustment for gender-related differences in age will reduce the risk. In addition, although highly relevant to the sport, little is known whether there are any gender-related differences in injury circumstances, diagnostics, treatment and return to play and these were secondary objectives with

our study.

MATERIAL AND METHODS

A prospective three-cohort study has been carried out since 2001 on men´s elite (professional) football in Europe as well as men´s and women´s elite football in Sweden in collaboration with the Union of European Football Associations (UEFA) and the Swedish Football Association. Several reports of the overall injury characteristics in these cohorts have been published over the years [11-12, 26, 46-47]. In addition, the methodology has also been reported in detail previously [25], and it follows the consensus statement on injury definitions and data collection procedures [17].

Study sample

A total of 57 clubs with 2329 players included were followed over a varying number of seasons from 2001 to 2009; 28 teams in European professional men´s first leagues from 11 football associations and 29 teams in the Swedish men´s (n=16) and women´s (n=13) first leagues. In total, 188 team-seasons and 4659 partial or complete player-seasons were included. All players belonging to the first team squads each season were invited to participate in the audit. Players injured before exposure data was collected were included, but their present injuries were not taken into account. Players who were transferred to other clubs or left their clubs due to other reasons before the end of a season were included for as long as they participated.

Data collection

Player age, leg dominance and a medical history of previous surgeries and severe injuries were reported by the club medical staff for each player at inclusion. A member of the medical or coaching staff registered individual exposure in minutes during all club and national team training sessions and matches during the season. All injuries resulting in time loss were recorded immediately after the event by a club medical officer. The information collected for each injury

included: player code, date of injury, training or match injury, injury type and location, contact or non-contact injury, recurrent injury or not, the referee's decision for match injuries, and a free-text diagnosis [25]. Injury cards and attendance records were sent to the study group once a month. After each reported ACL injury, the team physician or team physical therapist was sent an additional ACL injury card with information about match minute when the injury occurred, dates and results of diagnostic procedures used, treatment, dates of surgery, graft choice, and dates of return to full participation in training and match play. All ACL injuries were followed until return to football, even if the player was transferred to another club, except for career-ending injuries where no further data was collected.

Definitions

A time loss injury was defined as any physical complaint sustained by a player that results from a football training or match and leads to the player being unable to participate in future football training or match play [17, 25]. An ACL injury was defined as a first-time or recurrent partial or total rupture of the ligament occurring either isolated or associated with other concomitant injuries to the knee joint. A non-contact ACL injury was defined as the absence of any physical contact with another player or object at the time of injury according to the recording club medical officer. A knee sprain was defined as an acute non-bone distraction injury to the connective tissue, i.e. joint capsule and ligaments, of the knee joint. Other primary internal derangements such as cartilage and, meniscus lesions were classified separately. A player was considered injured until the team physician allowed full participation in all types of training or match play [17, 25]. The preferred kicking leg was regarded as the dominant leg. Foul play was determined according to the decision of the referee.

Ethics

Written informed consent was collected from each player according to the Declaration of Helsinki. The study protocol for the Swedish cohorts was approved by the Regional Ethical Review Board in Linköping, Sweden, and the study protocol for the European professional cohort was approved by the UEFA Football Development Division and the UEFA Medical Committee.

Statistical analyses

The players were divided in three separate groups: men's professional football in Europe (EUR men), men's professional football in Sweden (SWE men), and women´s elite football in Sweden (SWE women). For quantitative variables, groups were compared with the t-test or the analysis of variance (ANOVA) for normally distributed data and the Mann-Whitney U test or the Kruskal-Wallis test for non-normally distributed data. The χ^2 or the Fisher's exact tests were used for qualitative variables. Injury incidence is expressed as the number of injuries per 1000 exposure hours and compared between the groups as rate ratios (RR) using z-statistics [30]. To analyze female-to-male proportional hazard ratio, a Cox regression with time-dependent covariates was used with age and training ratio (training exposure/total exposure) entered as time varying covariates. Mean values are presented with the corresponding standard deviations (SD) or 95% confidence intervals (95% CI). All analyses were two-sided and the significance level was set at $p<0.05$.

RESULTS

During the study period, 9035 time-loss injuries were recorded and among them 574 were knee sprains (6%). In total, 76 players suffered 78 ACL injuries (two re-ruptures) constituting 0.9% of all time loss injuries and 14% of all knee sprains (Table 1). Players in SWE women were younger (22.9 ± 4.0 years) than in both EUR men (25.6 ± 4.5, $p<0.0001$) and in SWE men (25.0 ± 4.7, $p<0.0001$).

Insert Table 1 near here

Injury age

Mean age at ACL injury was 24.3 ± 4.5 years and was significantly lower in women compared to men (20.6 ± 2.2 vs. 25.2 ± 4.5 years, $p=0.0002$). Comparing the three cohorts, ACL-injured players in EUR men were older than in both SWE men (26.2 ± 4.0 vs. 22.9 ± 4.6 years, $p=0.0023$) and in SWE women (26.2 ± 4.0 vs. 20.6 ± 2.2 years, $p<0.0001$), but no difference was seen between SWE men and SWE women (22.9 ± 4.6 vs. 20.6 ± 2.2 years, $p=0.089$). No female player was older than 25 years at injury whereas the oldest ACL-injured male player was 33 years (Figure 1).

Insert Figure 1 near here

ACL injury incidence

The greatest gender-related difference in ACL injury incidence was seen during match play (Table 1). In the Cox regression, the female-to-male hazard ratio was 2.6 both when analyzed for all men (EUR men and SWE men) and SWE men only (Table 2). Adjusting for age, the hazard ratios were reduced to 2.4 and 2.1, respectively. Adjusting for training ratio was not significant when comparing SWE women and SWE men, but had some influence when comparing all men with the Swedish women (Table 2). Three-quarters of the ACL injuries occurred during match play and the overall match-to-training incidence ratio was significantly higher (RR 20.8, 95%CI 12.4 to 34.8) as were the ratios in all three cohorts (SWE women RR 16.2, 95% CI 5.1 to 50.7, SWE men RR 10.1, 95% CI 4.1 to 24.7 and EUR men RR 27.2, 95% CI 12.1 to 61.1).

Insert Table 2 near here

Injury circumstances

In total, 58% of the injuries resulted from non-contact (Table 1), and there were no significant differences between the three cohorts (p=0.29). Ten of the match injuries (17%) were the result of foul play, one of them due to own violation of the rules. Half of the ACL injuries affected the left knee and, similarly, the dominant limb (40 each).

Data for the exact match minute when the injury occurred was missing for 5 injuries (4 men's reserve team matches in Sweden and 1 men's European Champions League match where the player was able to play 90 minutes despite his injury). Slightly more than half of 59 match injures occurred in the first half (57% vs. 43%, p=0.31), but as many as 17 injuries were sustained

during the first 15 minutes of the match and another 7 injuries during the first quarter of the second half. A significantly higher frequency of ACL injury occurred in SWE women compared to SWE men (8 vs. 1 ACL injury, p=0.01) during the first quarter of the halves.

Diagnostics and associated injuries

The time to an established diagnosis of ACL injury was significantly longer in the two Swedish cohorts than in EUR men (8.1 ± 10.3 vs. 1.4 ± 1.6 days, p<0.0001). There was no difference between SWE men and SWE women (5.8 ± 7.7 vs. 11.1 ± 12.2 days, p=0.32). All 43 ACL injuries occurring in EUR men were primarily examined with MRI whereas the diagnosis in Sweden were based on clinical examination solely without the aid of MRI or arthroscopy in 8 of the 35 ACL injuries (p<0.0001). In ACL injuries examined primarily with MRI and/or arthroscopy, 63% were associated with concomitant injuries to other ligaments, menisci or joint cartilage (not taking bone marrow lesions into account). The most common associated injury was lateral meniscus (LM) tear (n=24) followed by medial collateral ligament (MCL) sprain (n=15); medial meniscus (MM) tear (n=11) and lateral collateral ligament (LCL) sprain (n=9).

Treatment and return to play

In total, 71 of the ACL injuries underwent ligament reconstruction; 5 partial ruptures were all treated without ACL surgery as well as 2 complete ruptures (one career-ending injury and one successful return to play after 92 days). The most frequent graft choice in EUR men was patella tendon autograft (21 of 38), but occasionally the iliotibial band or a patella tendon allograft were used (2 each). Hamstrings grafts were used significantly more often in Sweden than in Europe

(67% vs. 34%, p=0.028), and the ligament reconstructions were scheduled later after injury in Sweden (53.5 ± 64.7 vs. 18.0 ± 19.4 days, p<0.0001). There were no differences between SWE men and SWE women regarding graft choice (hamstrings 58% vs. 79%, p=0.28) or time to reconstruction (44.7 ± 36.0 vs. 65.3 ± 90.8 days, p=0.83).

Partial ruptures had a significantly shorter rehabilitation period than total ruptures undergoing ACL reconstruction (118.2 ± 81.7 vs. 231.6 ± 77.2 days, p=0.0023). Two reconstructed players were not able to return to football and another 3 players returned to lower level of play. The mean time to return to full training after ACL surgery was 201.8 ± 81.7 days; 28 of 69 players returned within 6 months. Two players were able to return to training after ACL surgery, but have no match exposure (one player finished his career after the season and the other player was released from his first team contract without having returned to match play as evaluated 17 months post-injury). The mean time to return to the first match appearance after ACL reconstruction for the rest of the players was 237.5 ± 76.1 days. The majority of the ACL reconstructed players returned to training within 10 months after surgery (94%) and participated in a match within 12 months after surgery (89%). There were no differences between the three cohorts in time to return to training or match play (Table 3). Similarly, there were no differences between bone-patella-bone tendon autografts and hamstring tendon autografts in time to return to training (216.9 ± 82.9 vs. 190.9 ± 46.4 days, p=0.12) or match play (253.8 ± 93.3 vs. 227.5 ± 58.6 days, p=0.18).

Insert Table 3 near here

DISCUSSION

The principal finding of the present study was that the incidence of ACL injury was significantly higher in female elite players. Female players were also significantly younger than male players when suffering their ACL injury and the female-to male ratio was reduced when adjusting for age. In addition, this study also confirms that match play is associated with a substantially higher ACL injury risk compared to training.

ACL injury epidemiology

The ACL injury risk has in some studies been reported to be higher at the elite level of play compared to lower levels [8, 38, 41]. Despite this fact, ACL injuries are relatively uncommon even at elite level compared to thigh muscle strains or ankle sprains irrespective of the gender studied [6, 13, 20, 26, 44, 46]. As shown in the present study, a men's team at the highest playing level can expect around 0.4 ACL injuries per season and a women´s team around 0.7 ACL injuries per season. Both the frequency of ACL injury and the ACL injury incidence was in line with most of previous injury surveillance studies in elite football [6, 20, 44]. However, in a study conducted on the German women's elite league during the 2003-2004 season [13], 11 ACL injuries were identified (all of them during match play) resulting in an incidence of 2.2 ACL injuries per 1000 match hours which is higher than in the present study. A repeated finding in all of these studies at elite or professional level, and also in some studies on collegiate football in the USA [4-5, 18-19], the ACL injury incidence has been considerably higher during match play, and this was also found in the present study (10-27 times higher).

Female-to-male ratio

Female football players have been shown to be more susceptible to ACL injury in several cohort studies of different settings [1, 4-5, 23, 18-19, 33]. Higher relative risks among female footballers have also been reported in Scandinavia from insurance claims [41], and surgery register data [8]. The female-to-male rate ratio reported in the present study corresponds very well to the ratios found in two recent reviews that identified an average risk increase among females of between two and three [36, 49].

Only a few studies in football, most often based on insurance claims data, have reported the ACL injury risk and age at injury according to gender. Although ACL injury is rare in pre-pubertal children, no difference has been found between girls and boys up to 12 years-of-age [42]. In a questionnaire survey based on surgery records from Norway, ACL-injured female players were significantly younger (19 vs. 27 years) than their male counterparts [8]. In another study, based on Swedish insurance claims, female players were also found to be significantly younger (19 vs. 23 years) and females younger than 20 years had a double risk compared to their male counterparts [41]. In the present study, a lower age at ACL injury in women compared to men was confirmed. In addition, the mean age of female elite players was lower than in males, indicating that age might be a confounding factor and should be adjusted for in gender-related comparisons of ACL injury risk [49]. When adjusting for age, the female-to-male ratio was reduced with up to 21% from 2.6 to 2.1 in the Swedish cohorts, thus supporting the notion about age as a significant confounder. The influence of gender-related differences in exposure is, however, somewhat conflicting and needs to be investigated further in future studies.

Injury circumstances

ACL injury seems to affect both knees to a similar extent as shown in this study, but also in another recent study on ACL reconstructed male players [38]. In addition, ACL injuries do not affect the dominant limb more often. This is perhaps not surprising, since the two most commonly described injury situations in football are turning of the trunk with the foot fixed to the ground or landing awkwardly from a jump [15, 38]. Most football-related ACL injuries seem to result from a non-contact injury mechanism with reported frequencies up to 84% [10, 13, 15, 20, 38]. A non-contact mechanism was also common in the present study, but most of the ACL injuries sustained among women were actually contact injuries, even if only 15 injuries were studied in total. In contrast, studies on college players in the USA have found a higher proportion of non-contact ACL injury among females than among males [1-2, 4, 10]. Separating the injuries resulting from contact or not is important, since it is primarily non-contact injuries that are addressed with structured warm-up programs with the aim of preventing ACL injury [21, 27, 32].

According to a Danish questionnaire survey, a tendency of a higher ACL injury frequency during the second half was seen [15]. In our study, we found no differences in ACL injury frequency between the two halves of a match, but female players often sustained their ACL injuries within the first 15 minutes of each half. This could simply be due to chance, but it could be speculated that there might be some gender-related differences in warm-up routines before kick-off and at half-time. For example, pre-exercise static stretching of the hamstrings, which is a known agonist of ACL, can result in a neuromuscular inhibition where the muscle becomes less responsive and is weakened for some time after the stretch [24].

Diagnostics and associated injuries

There was a longer delay to a confirmed diagnosis of ACL injury in Sweden which might reflect a lower degree of medical support in the clubs, differences in the general health care systems or simply different therapeutic traditions and attitudes. Excluding bone marrow lesions, which are seen more or less as a footprint of the injury mechanism in almost all typical ACL injuries [16], injuries to the lateral meniscus and MCL were the most common associated lesions. This probably illustrates the commonly described valgus load at the time of injury and much attention has been put to avoid dynamic knee valgus from a prevention perspective [27, 32].

Treatment and return to play

Some studies have reported difficulty in returning to play after ACL injury, at least at the same level as prior to the injury [8, 41, 43]. In one of the studies, only 28% of the ACL-injured male and female players still played football three years after injury [41]. As shown in the present study, most elite players are able to return to play at the same level as before the injury. However, return to football is often complicated and previous ACL injury has been associated with a significantly higher risk of new ipsilateral or contralateral ACL injury as well as any other future knee injury [16, 48]. One plausible explanation could be that standardised criteria for return to play after ACL injury are missing [29, 34]. Even if early return has been successful for example in a famous Italian international player who was able to participate in a match 77 days after ligament reconstruction [39], most surgeons advocate a period of six months before return to sports is allowed [29]. In the present study, the mean recovery time after ACL reconstruction was 201 days for training which is in agreement with a report from female elite players in Germany (192 days) [15]. The mean absence until first match appearance after undergoing ACL reconstruction was 238

days in our study and this is in line with the 232 days reported in another recent study on professional male players in Italy [40]. However, return to match play is influenced by several non-medical factors, e.g. coach selection, off-season holidays, transfer etc, and, therefore, return to full training might be a more reliable outcome.

There has been a major change of graft choice in Sweden during the latest decade with a majority of surgeons having hamstring tendons as their first-choice nowadays [22]. Although hamstring tendons were used more frequently in Sweden in the present study as well, no difference in return to play times depending on the graft choice was found and this has been found recently in another study as well [40]. However, hamstrings is an important agonist to the ACL and concerns have been raised that harvesting the semitendinosus (ST) tendon may result in an increased risk for recurrent ACL injury, since uninjured female football and team handball players with reduced electromyography pre-activity of the ST during a side-cutting maneuver have been shown to be at increased risk for future ACL injury [50].

Methodological considerations

The study design of the present study strictly adheres to the recent consensus guidelines of football injury surveillance [17]. In this statement, the strengths and limitations of injury surveillance studies such as this one are thoroughly discussed and will therefore not be repeated here in detail. The obvious strength of this study is that it was conducted over several seasons in a relatively homogenous population of elite footballers and thus comprises one of the largest samples of prospectively recorded ACL injuries in football to date. Another novel strength of the study is that

we adjusted for age as a potential confounder in the statistical model [49]. Since the female-to-male ACL injury ratio was reduced up to 21% when adjusting for age, it is our opinion that this should be routine in future studies evaluating gender-related differences in ACL injury risk. Moreover, we believe that we have been able to include all ACL injuries that occurred during the study period, since the ACL injuries were diagnosed by experienced club medical practitioners who often also referred the players to MRI within a few days after injury. It is known that ACL injuries in general are commonly misdiagnosed in the immediate post-injury period [16], but the risk of overlooking an ACL injury at the elite team sport level should be regarded as minimal [7].

The main limitation of this study is that the sample of ACL injuries was still rather small, especially for female players, thus reducing the statistical power of some analyses. In addition, there are some important differences in potential extrinsic risk factors between the European and the Swedish teams that also might influence the comparisons. For example, the climate zones between most of the European countries included vary from those in Sweden, and the Swedish league season (April to October/November) differ from most other European leagues. The two male cohorts were therefore separated in most analyses, but no difference in the ACL injury risk between men participating in the Swedish first league or in the European first leagues could be shown despite these differences in extrinsic risk factors. Another weakness is that the classification of contact injury was based on the opinion of the club medical officer who filled in the injury card. Ideally, injury mechanisms should be investigated less arbitrarily, for example using video analysis which has been done recently in other team sports such as basketball and team handball [28, 35]. To our knowledge, no similar study has been conducted in football. Similarly, associated lesions were reported by the club medical officer and, preferably, MR images could have been reviewed

by one single experienced musculoskeletal radiologist, but this was beyond the scope of the survey.

Conclusions

In this study on elite footballers, the ACL injury risk was higher among females compared to their male counterparts, but that gender-related differences in age should be taken into account when making comparisons of ACL injury risk. Other important findings of our study were that match play was associated with a much higher risk than training and that most injuries resulted from non-contact injury mechanisms. Finally, hamstrings grafts were used more often in Sweden, but there were no differences in time to return to play after ACL reconstruction between the three cohorts or between hamstring and patella tendon autografts.

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Conflict of interest

The authors declare that they have no conflict of interest.

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Table 1. Exposure and injury characteristics.

	EUR men	SWE men	SWE women
Teams	28	16	13
Players	1367*	652**	310
Exposure			
- Training	621110 hours (84%)	287111 hours (87%)	89536 hours (85%)
- Match	117498 hours (16%)	42736 hours (13%)	15242 hours (15%)
- Total	738608 hours	329846 hours	104777 hours
Time loss injuries	5791	2607	637
Knee sprains	394 (6.8%)	135 (5.2%)	45 (7.1%)
ACL injuries	43 (0.7%)	20 (0.8%)	15 (2.4%)
- Training	7	8	4
- Match	36	12	11
- Contact	17	7	9
- Non-contact	26	13	6
-			
- Partial ruptures	4	0	1
- Total ruptures	39	20	14
- Isolated	17	6	7
- Associated lesions	26	14	8
ACL injury incidence			
- Training	0.011 (0.0054 to 0.024)	0.028 (0.014 to 0.056)	0.045 (0.017 to 0.12)
Non-contact	0.0097 (0.0043 to 0.022)	0.017 (0.0072 to 0.042)	0.022 (0.0056 to 0.089)
- Match	0.31 (0.22 to 0.42)	0.28 (0.16 to 0.49)	0.72 (0.40 to 1.30)
Non-contact	0.17 (0.11 to 0.26)	0.19 (0.094 to 0.37)	0.26 (0.098 to 0.70)
- Total	0.060 (0.044 to 0.080)	0.061 (0.039 to 0.094)	0.14 (0.086 to 0.24)
Non-contact	0.035 (0.024 to 0.052)	0.039 (0.023 to 0.068)	0.057 (0.026 to 0.13)

EUR: European; SWE: Swedish; ACL: Anterior cruciate ligament

Injury incidence is reported as the number of injuries per 1000 exposure hours with a 95% confidence interval

* Two players participated in a European professional league before they were transferred to the Swedish first league

** Four players participated in the Swedish first league before they were transferred to different European professional leagues

Table 2. Cox regression with time-dependent covariates.

	Wald χ^2	Female-to-male hazard ratio
SWE women vs. SWE and EUR men		
Step 1		
Women	10.26	2.58 (1.44 to 4.60)
Step 2		
Women	8.18	2.35 (1.31 to 4.23)
Age*	3.19	0.95 (0.90 to 1.01)
Step 3		
Women	6.75	2.20 (1.21 to 3.98)
Age*	4.29	0.94 (0.89 to 1.00)
Training ratio*	21.98	0.00 (0.00 to 0.04)
SWE women vs. SWE men		
Step 1		
Women	7.39	2.62 (1.31 to 5.25)
Step 2		
Women	4.16	2.07 (1.03 to 4.17)
Age*	11.93	0.84 (0.76 to 0.93)
Step 3		
Women	4.63	2.18 (1.07 to 4.43)
Age*	10.42	0.84 (0.76 to 0.94)
Training ratio*	0.57	18.35 (0.01 to 34599.17)

EUR: European; SWE: Swedish

Hazard ratio is reported with a 95% confidence interval

* Time-dependent covariates

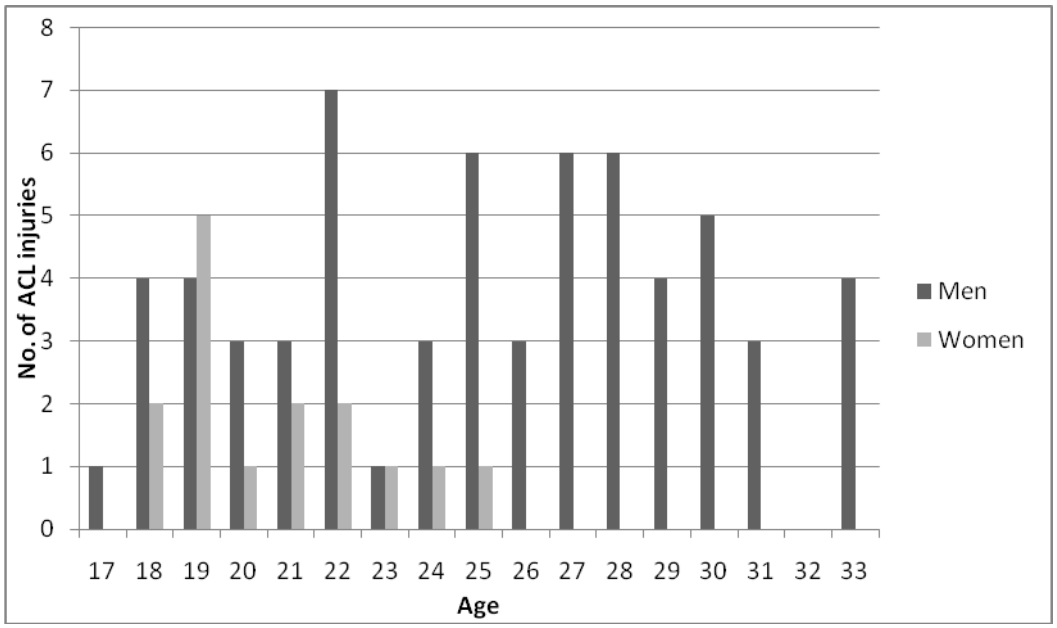
Table 3. Time to return to play after ACL reconstruction.

	EUR men	SWE men	SWE women	P-value
Time to return to training	201.5 (68.7)	203.4 (70.0)	201.4 (59.4)	0.996
Within 4 months	0 (0%)	1 (5%)	1 (7%)	
Within 6 months	15 (39%)	7 (37%)	6 (43%)	
Within 8 months	35 (92%)	15 (79%)	9 (64%)	
Within 10 months	37 (97%)	19 (100%)	11 (79%)	
Within 12 months	37 (97%)	19 (100%)	12 (86%)	
Time to return to match play	224.1 (75.8)	252.7 (80.5)	253.6 (67.9)	0.30
Within 4 months	0 (0%)	0 (0%)	0 (0%)	
Within 6 months	9 (24%)	6 (32%)	0 (0%)	
Within 8 months	31 (82%)	9 (47%)	7 (50%)	
Within 10 months	34 (89%)	15 (79%)	9 (64%)	
Within 12 months	35 (92%)	17 (89%)	11 (79%)	

EUR: European; SWE: Swedish; ACL: Anterior cruciate ligament

Time to return is reported as mean days of absence with standard deviation and the cumulative frequency of players able to return within 4, 6, 8, 10, and 12 months, respectively

Group differences analysed with ANOVA



ACL: Anterior cruciate ligament

Figure 1. Distribution of age at injury for ACL injuries.