

Injuries in adolescent female players in European football: a prospective study over one outdoor soccer season

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In this prospective study, injuries in 153 adolescent female soccer players were recorded during one outdoor season (April–October). The overall injury incidence rate was 6.8 per 1000 h soccer (games and practice) and the incidence rate of traumatic injury 9.1 and 1.5 per 1000 player-hours in games and practice, respectively. Sixty-three players (41%) sustained 79 injuries. Sixty-six percent of the injuries were traumatic and 34% were overuse injuries. Most of the traumatic injuries occurred

during games. Eighty-nine percent of the injuries were located in the lower extremities and 42% occurred in the knee or ankle. The most frequent type of injury was ankle sprain (22.8%). Forty-one percent of the traumatic injuries and 56% of the ankle sprains were re-injuries. Most of the injuries were of moderate severity (52%), while 34% were minor and 14% were major. Most of the major injuries were traumatic such as knee ligament injuries and ankle sprains.

European football (soccer) is one of the most popular sports in the world (McCarroll, Meaney, Sieber, 1984; Backous, Friedl, Smith, Parr, Carpine, 1988; Høy, Lindblad, Terkelsen, Helleland, Terkelsen, 1992; Inklaar, 1994; Tucker, 1997), with team members of all age groups and skill levels (Tucker, 1997). Until the early 1970s soccer was almost only played by men, but during the last two decades of the twentieth century the game rapidly increased in popularity among women (Brynhildsen, Ekstrand, Jeppson, Tropp, 1990; Engström, Johansson, Törnkvist, 1991; Davis & Brewer, 1993). The first European Championships for women was held in 1982 and the first World Cup in China, in 1991. Women's soccer has now established itself as a sport at the highest level (Davis & Brewer, 1993). Female soccer leagues have been in existence in Sweden for the last 25 years, making it historically one of the longest running in the world (Östenberg, Roos, Ekdahl, Roos, 1998). In Sweden, soccer is the most popular female team sport (Engström et al., 1991) and the second largest sport altogether after male soccer (Östenberg et al., 1998). Out of 198 260 licensed soccer players in Sweden, 39 128 are females and 22 186 of the females are younger than 20 years (Personal communication. The Swedish Soccer Association, June 1999).

Soccer is a contact sport and associated with a large number of injuries in both sexes (Engström et

al., 1991; Poulsen, Freund, Madsen, Sandvej, 1991; Lühje et al., 1996). Høy et al. (1992) and Tenvergert, Ten Duis and Klasen (1992) have reported that soccer injuries are responsible for approximately 40% of the total number of sports injuries treated at emergency departments in Denmark and the Netherlands.

Injuries in male soccer have been the subject of many studies (Nilsson & Roaas, 1978; Ekstrand & Gillquist, 1983; McCarroll et al., 1984; Maehlum, Dahl, Daljord, 1986; Nielsen & Yde, 1989; Ekstrand, Roos, Tropp, 1990; Engström, Forssblad, Johanson, Törnkvist, 1990; Poulsen et al., 1991; Schmidt-Olsen, Jørgensen, Kaalund, Sørensen, 1991; Andreasen, Faunø, Lund, Lemche, Knudsen, 1992; Kibler, 1993; Roos, Ornell, Gärdsell, Lohmander, Lindstrand, 1995; Árnason, Gudmunsson, Dahl, Jóhannsson, 1996; Inklaar, Bol, Schmikli, Mosterd, 1996; Lühje et al., 1996) but there are few studies concerning injuries in adult female soccer players (Möller-Nielsen & Hammar, 1989; Brynhildsen et al., 1990; Engström et al., 1991; Roos et al., 1995). Most studies in young female soccer players register injuries during a brief, but highly competitive period, such as a cup or a tournament (Nilsson & Roaas, 1978; Maehlum et al., 1986; Andreasen et al., 1992; Kibler, 1993). To our knowledge, there have been only two previous studies in young female soccer players registering injuries prospectively during a

considerable, continuous part of the season (Sullivan, Gross, Grana, Garcia-Moral, 1980; McCarroll et al., 1984).

The purpose of the present study was to investigate prospectively the incidence, type, location and severity of soccer related injuries among adolescent females during one entire outdoor season (April–October).

Material and methods

The study was approved by the Ethics Committee of the Medical Faculty, University of Umeå.

Subjects

A total of 175 adolescent female soccer players, chosen by age (14 to 20 years) and locality (city of Umeå), entered the study. At a clinical examination before the start of the study we found no abnormalities that excluded any of the players from participating in the study. Twenty-two players (13%) stopped playing soccer during the season, mainly because of other interests, and were consequently excluded from the study. None of these players stopped playing because of an injury. Therefore, the study is based on 153 soccer players from 10 different teams in the city of Umeå in the northeastern part of Sweden that were followed during one outdoor season (April–October 1996). The mean age of the players was 15.9 ± 1.2 years (range 14.1–19.2). Three girls played in the highest division (highest level in the country) and all the others at intermediate or recreational level. They had been playing soccer for 7.3 ± 2.1 years (range 1.5–13) and were at the time of the start of the study in soccer training for 3.9 ± 1.8 h/week.

Questionnaire

Before the start of the study the players answered a questionnaire assessing personal data, actual amount of training hours as well as former and present injuries.

Injury recording

All injuries associated with soccer and resulting in absence from at least one scheduled practice session or game were recorded by the players, in co-operation with their coaches/trainers. Two different standardized injury protocols were used: one protocol for traumatic injuries and one protocol for overuse injuries. These protocols are modifications of the protocols used by Ekstrand to register injuries in adult male soccer (Ekstrand, 1982). The location, type of injury, injury mechanism, duration of injury and previous injuries at the same site were recorded. During the season the authors had regular contact (depending on the number of injuries in the different teams) with the coaches/trainers and the players by both personal visits and telephone calls.

All injuries were diagnosed by one of the authors (K.S.). Some of the injuries were in the initial phase (acute), when there was no medical personnel available, diagnosed by the coaches/trainers or by the players themselves. However, in all cases contact was made with the physiotherapist (K.S.) for proper evaluation and diagnosis. In the case of a severe injury or uncertainty regarding an injury, the doctor was contacted for evaluation.

Injury definition

An injury was defined as traumatic if it had a sudden onset, associated with a known trauma, and as an overuse injury if the symptoms had a gradual onset without any known trauma. The player was defined as injured until she was able to take part fully in games and/or practice sessions.

Injury classification

Injuries were classified into the following three categories according to their severity: minor (absence from training/games <7 days); moderate (absence from 7 to 30 days); and major (absence >30 days) (Ekstrand & Gillquist, 1983; Engström et al., 1991). Injuries occurring at the end of the season were categorized according to the full duration of absence even if it exceeded the scheduled investigation time (Engström et al., 1991).

Table 1. Localization, type of injury and severity of traumatic injuries

| Localization | Type of injury | Absence from training/games | | | Total |
|-----------------|-----------------------------------|-----------------------------|-----------------------|-------------------|-------|
| | | Minor <7 days | Moderate 7–30 days | Major >30 days | |
| Upper extremity | Fracture, metacarpus | | | 1 | 1 |
| | Sprain | | 1 | | 1 |
| Back | Low back pain | | 1 | | 1 |
| Groin | Strain | | 1 | | 1 |
| Thigh | Contusion | 1 | | | 1 |
| | Strain | 5 | 8 | | 13 |
| Knee | ACL ^a +MM ^b | | | 1 | 1 |
| | MCL ^c | | 2 | 2 | 4 |
| | Patellar dislocation | | 2 | | 2 |
| Calf | Contusion | 1 | | | 1 |
| | Contusion | 1 | 1 | | 2 |
| | Strain | 1 | | | 1 |
| Ankle | Sprain | 5 | 9 | 4 | 18 |
| Foot | Fracture, dig 1 | | | 1 | 1 |
| | Subungual hematoma | | 1 | | 1 |
| | Contusion | 2 | | | 2 |
| | Sprain, toe | 1 | | | 1 |
| Total | | 17 | 26 | 9 | 52 |

^aACL: Anterior cruciate ligament; ^bMM: Medial meniscus rupture; ^cMCL: Medial collateral ligament.

Table 2. Localization, type of injury and severity of overuse injuries

| Localization | Type of injury | Absence from training/games | | | Total |
|--------------|---------------------------|-----------------------------|--------------------|----------------|-------|
| | | Minor <7 days | Moderate 7–30 days | Major >30 days | |
| Back | Low back pain | 1 | 4 | 1 | 6 |
| Hip | Trochanteritis | | 1 | | 1 |
| Groin | Adductor pain | 3 | | | 3 |
| Thigh | Muscle pain, hamstrings | 1 | | | 1 |
| Knee | Anterior knee pain | 1 | 5 | | 6 |
| | Contusion | | 1 | | 1 |
| Calf | Medial tibial syndrome | 3 | 2 | | 5 |
| | Achilles tendon, bursitis | | 1 | 1 | 2 |
| Foot | Ankle joint pain | 1 | | | 1 |
| | Metatarsal pain | | 1 | | 1 |
| Total | | 10 | 15 | 2 | 27 |

Practice and game recording

The number of practice hours and game hours were collected from diaries filled in by the players and their coaches/trainers. In the case of any missing information, an average value from the diaries of the current team was used. These values were then corrected for time of absence from practice and game due to possible injuries of that player.

Statistics

The SPSS package (SPSS Inc., USA) for personal computer was used for the statistical analysis. Descriptive information of the injuries was based on information gathered from the injury protocols. Mean (M) and standard deviation (SD) were used to describe continuous data, and frequency tables were used when data were categorical. Injury incidence rates were calculated according to the formula $I=A/R$, where A was the number of traumatic injuries during the study period and R was the sum of exposure time expressed as well in 1000 h of soccer, as in game and practice hours.

Results

The mean amount of training hours per player during the outdoor season was 46.9 ± 17.1 and the mean time of participation in competitive games was 29.5 ± 14.8 h/player.

During the period of this study, 63 players (41%) sustained 79 injuries. Fifty-two (66%) of the injuries were traumatic (Table 1) and 27 (34%) were overuse injuries (Table 2).

Seventy-nine percent ($n=41$) of the traumatic injuries occurred during games, and 21% ($n=11$) during training. The population at risk was 153, and the overall injury incidence rate (traumatic and overuse) was 6.8 per 1000 h soccer. The incidence rate of traumatic injury was 4.4 per 1000 h soccer (9.1 per 1000 game-hours, and 1.5 per 1000 practice hours). Comparing the incidence rate in different age groups, the highest incidence was seen in the age range 15–17 years (Fig. 1).

Types and locations of injuries

The type and location of the injuries are shown in Tables 1 and 2. The majority of injuries (89%) were located in the lower extremities and 42% occurred in

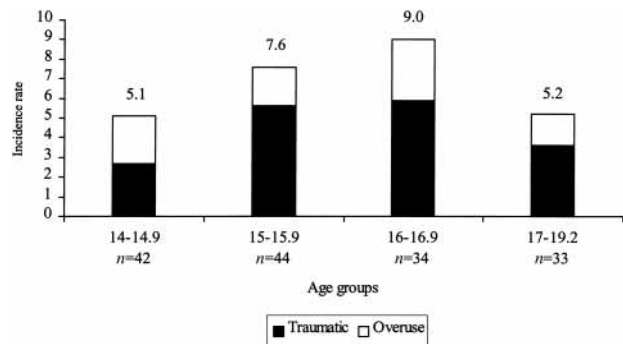


Fig. 1. Injury incidence rate (1000 h of soccer) in different age groups, n=the number of players in each age group.

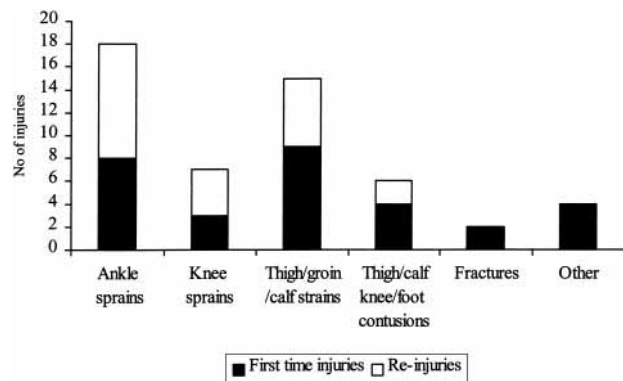


Fig. 2. The number of traumatic first time injuries and re-injuries in the lower extremities with regard to type and location. Knee sprains include meniscus ruptures, ACL and collateral ligament injuries.

the knee or ankle. The most frequent types of injuries were ankle sprains ($n=18$, 22.8%) and strains in the thigh muscles ($n=13$, 16.5%). Nine of the ankle sprains were non-contact injuries. Forty-one percent of all injuries (traumatic and overuse) were re-injuries (56% of the ankle sprains, and 40% of the muscle strains) (Fig. 2).

Severity

The severity of the injuries is presented in Tables 1 and 2. Fifty-two percent of the injuries (traumatic and overuse) were classified as moderate, while 34% were minor and 14% were major. Fifty percent of the traumatic injuries were moderate and 17% were major. Fifty-six percent of the overuse injuries were moderate and 7% were major. According to severity, the incidence rate per 1000 h soccer was: major injuries 0.94, moderate injuries 3.50, and minor injuries 2.31.

Out of the eleven major injuries, nine were traumatic (knee ligament injuries, $n=3$, ankle sprains, $n=4$, and fractures, $n=2$, Table 1). Three of the major ankle sprains were re-injuries. Five of the nine major traumatic injuries occurred during physical contact with another player.

Discussion

In this cohort study on adolescent female soccer players we decided to register prospectively all injuries during one outdoor soccer season. Most prospective studies on young female soccer players have registered injuries during a cup or a tournament, where many games are played in a short period of time (Nilsson & Roaas, 1978; Maehlum et al., 1986; Backous et al., 1988; Andreassen et al., 1992; Kibler, 1993). In our study we followed the players during a longer period with more ordinary playing and training conditions. A problem with prospective studies is that there will always be drop-outs. In the present study the drop-out frequency was 13%, and none of them was due to an injury. Another problem with prospective studies might be to maintain the motivation among the players and coaches/trainers, to complete the registration during the whole period. Therefore, we have been particularly careful about keeping regular contact with all teams throughout the whole season.

The difficulties in comparing the results from different epidemiological soccer studies because of differences in injury definitions have previously been discussed (Keller, Noyes, Buncher, 1987; Van Mechelen, Hlobil, Kemper, 1992; Inklaar, 1994). Keller et al. (1987) suggest that only injuries resulting in absence from practice or games should be included in the statistics of this kind of study. They also emphasize the

importance of reporting the duration of absence from training and games as it represents a useful measure of the severity of injury. In the present study we followed both these recommendations. The only other study in females using both these definitions is that by Engström et al. (1991) that contains information about adult elite players. The most comparable investigation on young female soccer players, with partly similar conditions to those in our study, is that by Sullivan et al. (1980) who registered injuries among young males and females (aged 7 to 18 years) during one season. However, that investigation was performed more than 20 years ago. Since then, changes such as increased training volumes, pre-seasonal conditioning, and better protective equipment have been introduced. Therefore, there is no previous study on young female soccer players that we can directly compare our study with.

We found that about two-thirds of the injuries in our study were traumatic. That is the same as Engström et al. (1991) found in their study on elite adult players. Most of the traumatic injuries in our study occurred during games, which also have been shown by others (Sullivan et al., 1980; Engström et al., 1991). Compared to the study by Engström et al. (1991), the players in our study had a higher game/training ratio, i.e. they spent much time playing games and had reduced time for training. A reason for this might be that, in young age groups, especially the more talented players play games with several teams (different age groups), and therefore have reduced time left over for training.

The incidence of injury in our study, 6.8/1000 h of soccer, is considerably higher than Sullivan et al. (1980) found in young female players aged 7 to 18 years (1.1/1000 h). Most of the players in their study were younger than our players. Their results show higher injury rates for players older than 12 years compared to the younger players. Unfortunately, in their study, the number of injuries in different age groups is not related to time of exposure, and is therefore not comparable to our figures. Engström et al. (1991) reported an injury incidence of 12/1000 h in elite adult players.

The majority of injuries in our study were located in the lower extremity, which is in accordance with the results from other studies (Sullivan et al., 1980; McCarroll et al., 1984; Maehlum et al., 1986; Backous et al., 1988; Brynhildsen et al., 1990; Engström et al., 1991; Andreassen et al., 1992; Kibler, 1993). Similar to many other studies (Sullivan et al., 1980; McCarroll et al., 1984; Backous et al., 1988; Brynhildsen et al., 1990; Engström et al., 1991), the most frequent injury in our study was ankle sprain. Most of the ankle sprains were non-contact injuries. The reason for this type of injury might be multifactorial, such as bumpy playing surface, the shape of

the cleats, poor muscle function and balance. Baumhauer, Alosa, Renström, Trevino and Beynnon (1995) have shown that individuals (both men and women) with a muscle strength imbalance, as measured by an elevated eversion-to-inversion ratio (>1.0), exhibited a higher incidence of inversion ankle injury. Furthermore, ankles with a greater plantar flexion strength and an associated muscle strength imbalance, as calculated by a smaller dorsiflexion to plantar flexion ratio, had a higher incidence of inversion ankle sprain. More than half of the ankle sprains in our study were re-injuries, possibly caused by inadequate rehabilitation of the previous ankle sprain. In our experience, these injuries are often considered as mild both by the coach and the player. Therefore, the rehabilitation might be limited, and the player might be back in games and ordinary training too soon after the injury. Coordination training on an ankle disk, and the use of external support such as an ankle brace or taping, have been shown to reduce the frequency of ankle sprains in soccer players with previous ankle problems (Tropp, Askling, Gillquist, 1985; Surve, Schweltnus, Noakes, Lombard, 1994). In a recent study, we could not show any benefit of balance board training in prevention of injuries to the lower extremities in female soccer players (Söderman, Werner, Pietilä, Engström, Alfredson).

Although our clinical experience is that major knee injuries such as an anterior cruciate ligament (ACL) injury are relatively common in female soccer, we could not confirm this in our study. Only one player in our study sustained an ACL injury. However, the number of participants is too small to specifically study major knee injuries, because one injury more or less greatly affects the incidence rate. The incidence rate of ACL injuries has, to our knowledge, not been presented in any prospective study with a sufficient number of participants. Studies with many participants and a follow-up period of more than one season needs to be performed, but difficulties such as the common large number of drop-outs among adolescent players needs to be taken into account.

The majority of injuries in our investigation were of moderate severity, compared to the study by Engström et al. (1991) on adult players who reported a majority of minor injuries. It is difficult to explain this difference, but in adult players (especially in higher divisions) the demand to return to games soon after an injury is most probably higher. Another factor might be that the adult players receive a better primary medical care, with an appropriate acute

treatment followed by a proper rehabilitation, and might therefore be able to return to soccer earlier.

In our study the highest injury incidence rate was seen in players 15 to 17 years old, which is in agreement with other studies carried out either during ordinary soccer season (Sullivan et al., 1980), or during a cup or a tournament (Backous et al., 1988; Andreassen et al., 1992). A possible explanation for this might be that the players in this age group often play soccer against older, more mature and heavier opponents.

In conclusion, the adolescent female soccer players in the present study had a lower injury incidence rate compared to those reported in studies on adult female soccer players. The injuries were most often of moderate severity and the most frequent injury was ankle sprain, often appearing as a re-injury. Since ankle sprains comprised a large proportion of the injuries, future studies aimed to evaluate preventive strategies for these injuries are recommended.

Perspective

Female soccer has grown rapidly in the last decades, and many of the participants are in adolescence or even younger. Since previous prospective studies on adolescent female soccer players (Sullivan et al., 1980; McCarroll et al., 1984) are quite old, our study could be seen as a description of the current injury pattern in these age groups. Descriptive studies are important to try to identify injury patterns. We found surprisingly many re-injuries, especially ankle sprains that possibly can be prevented by instituting appropriate rehabilitation after the injury. Interestingly, the players in our study had a high game/training ratio, and maybe more training and less participation in games (especially for young girls playing in higher divisions against older and heavier opponents) in these young age groups could decrease the amount of injuries.

Key words: soccer; adolescent females; soccer injuries; epidemiology.

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