

# Injuries among Swedish female elite football players: a prospective population study

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**Injury occurrence in all 12 female elite senior football teams in premiere league was registered during 1 year. Of 269 players, 129 (48%) sustained 237 injuries. The total injury incidence was 4.6/1000 h of football. The injury incidence during practice was 2.7 and during the game time was 13.9/1000 h. The highest injury incidence during practice was to the knee (0.8/1000 h) and thigh (0.5/1000 h), and during game time was to the knee (4.4/1000 h) and head (2.2/1000 h). In total, the location for the highest injury incidence was the knee with 1.5 injuries/1000 h of football.**

**The majority of injuries (82%) were localized to the lower**

**extremities. Sixty-six injuries (28%) were re-occurring injuries (re-injuries). The incidence of traumatic injuries was 3.3/1000 h of football and for overuse injuries 1.3/1000 h. Overuse injuries occurred mainly during the pre-season and at the beginning of the spring season.**

**Thirty-nine percent of the injuries were slight or minor causing absence from practice or game time of less than 1 week, 39% were moderate (absence 7–28 days) and 22% were major (absence more than 28 days). The major injuries occurred often owing to trauma and were mainly to the knee.**

Football is a popular female team sport played by approximately 40 million women in over 100 countries the world over ([www.fifa.com](http://www.fifa.com)). In Sweden, football is the largest female team sport, with almost 40 000 players ([www.svenskfotboll.se](http://www.svenskfotboll.se)).

Several studies have been published during the recent decades regarding injury patterns in male football players (Ekstrand, 1982; Tysvaer & Lochen, 1991; Tysvaer, 1992; Inklaar, 1994a; Chomiak et al., 2000; Dvorak & Junge, 2000), including studies concerning skill-level differences (Poulsen et al., 1991; Junge et al., 2000; Peterson et al., 2000). Inklaar (1994a, b) and Dvorak and Junge (2000) concluded from their reviews of the literature that injury incidence is higher during game time (7.4–37.2 injuries/1000 h) than during practice (1.5–7.6 injuries/1000 h), that 60–90% of all injuries occur in the lower extremities and that incidence of injury increases with age. The causes of injury are believed to be multifactorial, such as intrinsic factors, e.g., joint instability, muscle strength, muscle tightness, body asymmetry, biomechanics, psychological factors, as well as extrinsic factors, e.g., level of play, position on the field, amount and standard of practice/game, equipment, pitch conditions, rules and fair play. Previous injuries and inadequate rehabilitation are also factors to account for (Inklaar, 1994b; Chomiak

et al., 2000; Dvorak & Junge, 2000; Dvorak et al., 2000).

Different injury rates and distribution of injuries have been shown for male and female football players (Nilsson & Roaas, 1978; Ekstrand, 1982; Engstrom et al., 1991; Tysvaer & Lochen, 1991; Tysvaer, 1992; Inklaar, 1994a; Chomiak et al., 2000; Dvorak & Junge, 2000; Ostenberg & Roos, 2000; Soderman et al., 2001).

The injury incidence for female players seems to be lower than for males (Dvorak & Junge, 2000). As for male players, the incidence is higher during game time (9.1–24 injuries/1000 h) than during practice (1.5–7 injuries/1000 h) (Engstrom et al., 1991; Ostenberg & Roos, 2000; Soderman et al., 2001).

Lately, attention has been focused on the higher risk of knee injuries among female football players (Engstrom et al., 1991; Arendt & Dick, 1995; Roos et al., 1995) and on the fact that they sustain their knee injuries at an earlier age (Ostenberg & Roos, 2000). The mean age for sustaining an anterior cruciate ligament injury in female football players is 19 years compared with 23 years among male players (Roos et al., 1995).

In male football players, head injuries account for 4–22% of all football injuries (Dvorak & Junge, 2000). Male players were found to have at least

double the risk than female players of sustaining a concussion (Barnes et al., 1998).

Injuries among female football players have not been thoroughly investigated. More specifically, prospective studies of the injury incidence over an entire football season in a large group of elite female football players have not been conducted. Such studies are important to be carried out in order to avoid different biases such as recall bias in a retrospective study and bias owing to variation of injuries over the season.

### Aim

The aim of this prospective population study was to investigate injuries and injury rates among all Swedish female elite football players in premiere league during an entire football season.

### Materials and methods

#### Materials

All 12 female senior football teams from the premiere league in Sweden were invited to participate in this prospective cohort population study, and they all accepted the invitation. All active players in the teams at the beginning of the football season ( $n = 269$ ) were included in the study and followed until their individual time of dropout. Players recruited to the teams during the study period were not included in the study.

In order to study total football exposure for these elite players, the women's national team and U-21 (under 21 years) the national team, were also studied. The players that, on any occasion, had played on the national women's or U-21 team during the investigated year are referred to as national team players. All other players are referred to as non-national team players.

The studied teams were also divided into two subgroups: the three highest ranked teams in the league at the end of the season compared with the three lowest ranked teams.

#### Method

In Sweden, football is mainly a summer sport. The training period begins in November and practice games and tournaments start in January. The competitive season starts in April and ends in October. The investigated period in this study included both preseason (January 1 to the April 23) and the competitive season (April 24 to October 29 2000).

Before the beginning of the investigation, the first author visited all the teams to give a presentation and inform them about the study.

Participation in club/team-scheduled practice and game sessions as well as injuries were registered by the respective trainer/coach, using standardized attendance protocols (Ekstrand, 1982). Individual participation and injuries in the national women's and U-21 teams were registered by the physiotherapist for each team.

The attendance protocol was reported once a week from the club teams, or after every national gathering, to the first author. The duration of each scheduled practice was approximated to 120 min and a scheduled game session was 90 min for both national and non-national teams.

The reported injured players were interviewed by telephone by the first author using a standardized protocol that included location of injury, injury mechanism, type of injury, occasion of injury, playing position, dominant foot, ball contact, foul play, re-injury, medical consultation, treatment, etc. (Ekstrand, 1982). Injuries occurring at the end of the investigational period were followed-up according to their full duration or up to 18 months beyond the investigational period.

### Definitions

An *injury* was defined as damage to the body sustained during practice or game session causing absence from at least the following practice and/or game session. A *traumatic injury* was an injury with a known trauma.

An *overuse injury* was an injury without any known trauma. *Sprain* was defined as a ligament injury and *strain* as a distension injury to the muscle-tendon unit. *Re-injury* was defined as a new injury sustained within 2 months after an earlier injury at the same bodily location. The player was defined as *injured* until she considered herself able to participate fully in the practice and/or game time.

Injuries were categorized as *slight* (absent from practice and/or game 1–3 days), *minor* (absent 4–7 days), *moderate* (absent 8–28 days) or *major* (absent more than 28 days) (Hagglund et al., 2003).

*Foul play* was defined as a situation during game time that was interrupted by the referee and that led to a free kick/penalty kick.

*Injury incidence* was defined as the number of injuries/1000 h of football activity.

### Statistical analysis

The statistical procedures were performed with SPSS (SPSS Inc., Chicago, USA, version 11.0) for personal computer. Standard statistical methods were used to calculate means, range and standard deviation. As this was a population study, no hypothesis testing procedure was used to compare groups.

### Ethics

The study was approved by the Ethical Committee of the Medical Faculty at the University of Umeå. The medical committee of the Swedish Football Association (SvFF), the teams, the trainers/coaches and the players all received verbal and written information about the study and gave their informed consent before the investigation.

### Results

After participating for 2 months of the investigational period, one team (27 players) chose to drop out. After 6 months, another team (18 players) did not want to continue to register and report injuries, thereby leaving 224 players.

During the season, another 29 players quit playing football in the premiere league owing to varying circumstances such as injury (6), moving to USA to play football (4), work (3), loss of interest (2), physical complaints (2), disagreements with the team/coach (2), not making the team (2), or

unknown reasons (8). At the end of the season, 195 players of the original 269 (72%) remained.

The mean age for the players in this study was 23 ± 4 (16–36) years, height 168 ± 5 (155–184) cm, weight 62 ± 7 (48–98) kg and BMI 22 ± 2 (18–30). Twelve percent of the players were goalkeepers, 29% were defenders, 36% were midfielders and 23% were forwards. Most players were right footed (69%).

On the average, the teams had 140 ± 48 (24–238) practice sessions and played 35 ± 12 (2–48) games during the season. The main difference between the number of scheduled practice and game sessions was a result of dropouts. The average individual participation was 66% both in practice and competitive games.

During the investigated year, 51 players were selected to join the national women’s team or the national U-21 team. The national women’s team and the U-21 team had 52 scheduled practice sessions and played 23 games during the season. National team

players were taller (170 ± 5 vs 167 ± 5 cm) and had more total football exposure compared to non-national players (Table 1).

The players in the three highest ranked teams in the league at the end of the season had more practice hours during the preseason (111 ± 57 vs 93 ± 30 h) than the players in the three lowest ranked teams. The highest ranked teams also had more practice hours (163 ± 76 vs 121 ± 46 h) during the competitive season as well as total football hours (321 ± 134 vs 257 ± 78 h) during the whole season.

Younger players, in the lower age quartile (<20 years), had more preseason practice hours (91 ± 39 vs 86 ± 47 h), preseason game hours (11 ± 6 vs 10 ± 7 h), total preseason football hours (103 ± 43 vs 96 ± 53 h), total practice hours (202 ± 92 vs 191 ± 116 h), and total football hours (242 ± 109 vs 227 ± 135 h) than players in the higher age quartile (>26 years).

Of the 269 players, 129 (48%) sustained 237 injuries during the season. Sixty-four players received one injury, 44 two injuries, 10 three injuries and 11 players received four or more injuries. Eighty-two percent of all injuries were localized to the lower extremities and equally distributed between the left and right sides.

The incidence of injury during practice was 2.7/1000 h and during game time was 13.9/1000 h (Table 2).

The practice/game ratio was 5 ± 4. No difference was found between national and non-national team players. Players in the three highest ranked teams had a higher practice/game ratio than players in the three lowest ranked teams (6 ± 5 vs 5 ± 1). Injured players had a higher practice/game ratio than non-injured players (6 ± 4 vs 5 ± 3).

During both practice and game sessions, the knee had the highest injury incidence in relation to location. The incidence of head injuries was almost 40 times and ankle injuries almost 10 times higher

Table 1. Exposure (hours), means and standard deviation (SD), during the pre-season (1 January–23 April) and the competitive season (24 April–29 October) for national team players (n = 51) vs non-national team players (n = 218)

	National team players	Non-national team players	Total
	Mean ± SD	Mean ± SD	Mean ± SD
<b>Practice</b>			
Pre-season	102 ± 43	82 ± 45	86 ± 45
Competitive season	151 ± 60	96 ± 69	108 ± 71
Total season	252 ± 96	178 ± 104	194 ± 107
<b>Games</b>			
Pre-season	14 ± 7	9 ± 7	10 ± 7
Competitive season	38 ± 13	24 ± 17	27 ± 17
Total season	52 ± 16	33 ± 21	37 ± 22
<b>Total football</b>			
Pre-season	115 ± 47	91 ± 50	96 ± 50
Competitive season	189 ± 68	120 ± 83	134 ± 85
Total season	304 ± 107	211 ± 122	231 ± 125

Table 2. Incidence of practice and game injuries (injuries/1000 h)

	Practice		Game		Total	
	n (%)	Injuries/1000 h	n (%)	Injuries/1000 h	n (%)	Injuries/1000 h
Foot	7 (6)	0.1	9 (8)	0.7	16 (7)	0.2
Ankle	12 (10)	0.2	19 (16)	2.0	31 (13)	0.5
Lower leg	16 (13)	0.4	9 (8)	1.5	25 (11)	0.5
Knee	29 (24)	0.8	30 (26)	4.4	59 (25)	1.5
Thigh	24 (20)	0.5	22 (19)	1.7	46 (19)	0.9
Hip, groin	12 (10)	0.2	5 (4)	0.4	17 (7)	0.3
Spine	14 (12)	0.3	5 (4)	0.5	19 (8)	0.3
Trunk	3 (2)	0.1	3 (3)	0.2	6 (3)	0.1
Head	2 (2)	0.1	12 (10)	2.2	14 (6)	0.3
Upper extremities	2 (2)	0.0	2 (2)	0.2	4 (2)	0.1
Total	121 (100)	2.7	116 (100)	13.9	237 (100)	4.6

Table 3. Incidence of traumatic and overuse injuries (injuries/1000 h)

	Trauma		Overuse		Total	
	n (%)	Injuries/1000 h	n (%)	Injuries/1000 h	n (%)	Injuries/1000 h
Foot	7 (4)	0.1	9 (12)	0.1	16 (7)	0.2
Ankle	25 (15)	0.4	6 (8)	0.1	31 (13)	0.5
Lower leg	12 (7)	0.2	13 (18)	0.3	25 (11)	0.5
Knee	30 (18)	0.9	29 (39)	0.6	59 (25)	1.5
Thigh	45 (28)	0.9	1 (1)	0.0	46 (19)	0.9
Hip, groin	14 (9)	0.2	3 (4)	0.0	17 (7)	0.3
Spine	7 (4)	0.1	12 (16)	0.2	19 (8)	0.3
Trunk	6 (4)	0.1	0	0.0	6 (3)	0.1
Head	14 (9)	0.3	0	0.0	14 (6)	0.3
Upper extremities	3 (2)	0.1	1 (1)	0.0	4 (2)	0.1
Total	163 (100)	3.3	74 (100)	1.3	237 (100)	4.6

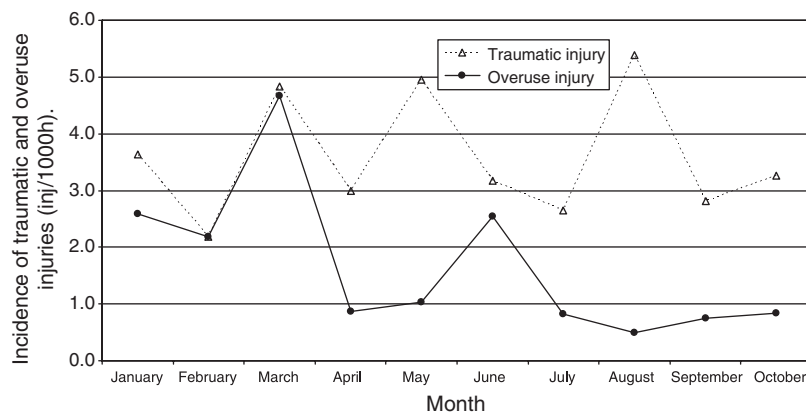


Fig. 1. Distribution of traumatic and overuse injury rate over one football season.

during game compared with practice sessions (Table 2).

No difference in injury incidence was found for players under/over the mean age (23 years). Players in the higher quartile (>26 years) had a higher incidence for ankle injuries during practice sessions ( $0.3 \pm 1.2$  vs  $0.0$ ) as well as knee overuse injuries ( $0.6 \pm 1.6$  vs  $0.1 \pm 0.8$ ) compared with players in the lower quartile (<20 years).

Most of the injuries were traumatic (163/237, 69%). The incidence of traumatic injuries was 3.3/1000 h of football (Table 3). The highest incidence for traumatic injuries was to the knee and thigh, followed by the ankle and head. The distribution of traumatic injuries over the year is shown in Fig. 1.

The incidence of overuse injuries was 1.3/1000 h of football (Table 3). Overuse injuries were distributed with the highest incidence to the knee, the lower leg, and the spine. Overuse injuries occurred mainly during preseason and at the beginning of the spring season (Fig. 1).

Seventeen percent of all injuries were classified as slight, 22% as minor, 39% as moderate and 22% as major injuries. The major injuries occurred often owing to trauma (33/52) and were mainly to the

knee (30/52). The most common type of major injury was sprain (26/52) and overuse (16/52). The injury incidence in relation to location and severity of injury is outlined in Table 4. At follow-ups 18 months after major injuries, 49 of the 52 players were once again playing football. The three players that were not back within 18 months all had serious knee injuries.

The highest injury incidence in relation to type of injury was in strains, sprains and overuse (Table 5).

Forty-five percent (107/237) of all injuries occurred during ball contact. Forty-nine percent ( $n = 116$ ) of all injuries occurred during game time. Of these 116 injuries, 19% were owing to foul play.

Forwards had the highest injury incidence during both practice and game ( $3.8 \pm 6.8$  vs  $18.7 \pm 38.9$ ), followed by defenders ( $2.6 \pm 6.0$  vs  $16.2 \pm 24.6$ ), midfielders ( $2.3 \pm 7.9$  vs  $11.8 \pm 36.6$ ) and goalkeepers ( $2.1 \pm 4.1$  vs  $5.2 \pm 17.1$ ).

Fifty-eight percent (137/237) of the injuries occurred to the same body part (e.g., same leg) as an earlier injury within the previous 2 months, and 28% (65/237) were re-injuries at the same location.

Seventy-four percent of all re-injuries (48/65) occurred during practice. The re-injuries were overuse injuries (30/65), sprains (15/65), strains (19/65) and a

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Table 4. Injury incidence/1000 h of football in relation to location and severity of injury

	Slight ( <i>n</i> = 41, 17%)	Minor ( <i>n</i> = 52, 22%)	Moderate ( <i>n</i> = 92, 39%)	Major ( <i>n</i> = 52, 22%)	Total ( <i>n</i> = 237)
Foot	0.0	0.1	0.1	0.0	0.2
Ankle	0.0	0.2	0.1	0.1	0.5
Lower leg	0.1	0.2	0.1	0.1	0.5
Knee	0.1	0.2	0.2	1.0	1.5
Thigh	0.1	0.3	0.4	0.1	0.9
Hip, groin	0.0	0.1	0.1	0.0	0.3
Spine	0.1	0.1	0.1	0.1	0.3
Trunk	0.0	0.0	0.0	0.0	0.1
Head	0.0	0.1	0.1	0.0	0.3
Upper extremities	0.0	0.0	0.0	0.0	0.1
Total	0.6	1.3	1.2	1.5	4.6

Table 5. Injury incidence/1000 h of football in relation to type of injury

	<i>n</i> (%)	Injuries/1000 h
Laceration	3 (1)	0.1
Concussion	9 (4)	0.1
Fracture	3 (1)	0.0
Dislocation	2 (1)	0.0
Contusion	20 (8)	0.4
Sprain	58 (24)	1.3
Strain	68 (29)	1.3
Overuse	74 (31)	1.3
Total	237 (100)	4.6

concussion (1/65). Forty percent of the overuse injuries and 28% of the strain injuries were re-injuries.

### Discussion

The principal findings of this prospective population study were the high incidence of knee and head injuries during games, the high number of re-injuries, that the injury incidence for players in teams that had the highest exposure to football (national team players and players from the top three teams) was not different from the injury incidence of their counterparts and that injured players had higher practice/game ratio than non-injured players.

The first step in prevention of sport injuries is to identify and describe the injury incidence. Since the definition of a football injury and the study designs differ between studies (Junge & Dvorak, 2000; Ekstrand & Karlson, 2003), comparisons are difficult to make. The study design we chose has been used in several previous studies (Ekstrand, 1982; Engstrom et al., 1991; Ostberg & Roos, 2000; Soderman et al., 2001).

Most prospective studies of female football players have registered players during cups, tournaments or parts of the season (Nilsson & Roaas, 1978; Maehlum et al., 1986; Backous et al., 1988; Andreassen et al., 1992; Kibler, 1993; Ostberg & Roos, 2000;

Soderman et al., 2001). In this prospective population study, we chose to register all injuries during an entire football season in the premiere league. To attain the total exposure and injury rate for all players in the premiere league, we included players' attendance in the two senior national teams, women's, and U-21. Since 2000 was the year of the Olympic Games in Sidney (September 13–28), the national competitive football season took a short break during this time and was therefore prolonged until the end of October.

In order to minimize the collecting bias, a telephone interview followed a standardized protocol and was conducted by the first author.

All teams did not have physicians available to diagnose all injuries. As teams in the premiere league come from all over Sweden, the geographical distance made it impossible for clinical investigations of the injuries by the authors. Therefore, no diagnoses could be established. This is a bias that has to be taken into account.

One of the problems with prospective studies is in maintaining the motivation among the teams to complete the registration appropriately during the whole period. In order to minimize this bias during data collection the first author kept weekly contact with all teams throughout the season. In this study, leaders of two teams did not have the motivation to fulfil the request of reporting injuries. Another 29 players quit during the season, which caused the dropout to be 26% (71/269). This is more than the 13% (22/175) found by Soderman et al. (2001) and Ostberg and Roos (2000) where no dropouts were reported.

The approximation of time to 120 min for scheduled practice sessions was decided after discussions with the coaches and players on both national and non-national levels. The mean time for practice sessions was reported to be 2 h. The optimal study method would be to register the player's exact individual exposure time, which has been done in some studies (Hagglund et al., 2003; Ekstrand et al.,

2004). Approximation of time could lead to over- or underestimation of injuries.

The participation rate was quite low (66%), considering that these were premiere league players. Our results are in exact accordance with studies on male players on recreational level, 66% (Ekstrand & Gillquist, 1983; Ekstrand et al., 1983), but lower than another study of male elite football players, 79% (Engstrom et al., 1990). The reason for this is unknown. One hypothesis could be that female players are amateurs while male players are professional.

The injury severity was divided into four categories – slight, minor, moderate and major (Hagglund et al., 2003). The reason for this was to classify the minor injuries into two groups, one likely not to miss a game (1–3 days) and the other more likely to miss a game (4–7 days). Absence between 1 week and 1 month means that the player misses several games, and absence over 1 month is a result of a serious injury. This classification does not stand in any contradiction with other classifications, such as minor (1–7 days), moderate (8–28 days) and major (>28 days) (e.g., Ekstrand et al., 2004).

Injury incidence is defined as the number of injuries per hours of exposure occurring during a study period. The incidence of injury in this study was 2.7 injuries/1000 h of practice and 13.9 injuries/1000 h of game. This differs partly from Ostenberg and Roos's (2000) (3.7 and 14.3/1000 h for practice and game, respectively) and Soderman et al.'s (2001) incidence of injury (1.5 and 9.1, respectively). However, the injury incidence in our study is lower than that reported by Engstrom et al. (1991) (7 and 24, respectively). These differences could be a result of differences in study design, such as different age groups and different playing levels. Ostenberg and Roos (2000) studied 123 players from five different league levels and Soderman et al. (2001) studied 175 players from the recreational level to premiere league. Engstrom et al. (1991) studied one team in the premiere league and one team in the third league level. Differences in injury incidence in female football players related to age and play level need to be investigated further.

The development within the sport over time could be another explanation. It should be noted that there are nearly 10 years between the Engstrom (1991) study and the studies by Ostenberg and Roos (2000), Soderman et al. (2001) and our study.

Different factors could influence the injury incidence. For male football players it has been shown that high practice to game ratio is beneficial concerning risk of injury (Ekstrand et al., 1983; Hagglund et al., 2003). This could not be shown in our study, and the reason for this gender difference is unknown.

Of note is the high incidence of head injuries during game time (2.2/1000 h). Barnes et al. (1998) reported that 43% of the women in their study had experienced some type of head injury during their football careers. The most common head injury situation is collision with another player or getting hit in the head by the ball (Dvorak & Junge, 2000). Traumas to the head can cause neuropsychological symptoms regarding attention, concentration, memory, judgment and thus is to be considered a concussion (Tysvaer & Lochen, 1991; Tysvaer, 1992; Matser et al., 1998; Matser et al., 1999; Aubry et al., 2002). Special helmets that protect the head have now been introduced and are seen more frequently during international games, but scientific evaluations of these helmets are still limited. Headgear is intended to reduce the force of impact, so that the symptoms associated with mild head injuries are minimized, and ultimately some slight head injuries could be avoided (Lewis et al., 2001; Janda et al., 2002; Naunheim et al., 2003). Headgears were not used by any of the players in our study. Further studies concerning headgears are necessary before general medical recommendations can be made.

The differences in skill levels between teams within the premiere league are high. In the top of the league, the teams consist of several national team players. Players of a lower skill level, who play against national and international top players, might have tempo difficulties during games. This could lead to fatigue and result in traumatic injuries and overuse injuries.

Several studies concerning football injuries in varying age groups, both female and male, show that differences in injury incidence in different age groups are apparent (Hoff & Martin, 1986; Backous et al., 1988; Schmidt-Olsen et al., 1991; Andreassen et al., 1992; Junge et al., 2000; Junge et al., 2002). We found no difference in injury incidence concerning players over or less than 23 years of age (mean age). The hypothesis that young (lower quartile) skilled players, who are recruited from smaller clubs and exposed to the higher level of practices and games, receive more overuse injuries after a period of time was not supported.

The high number of traumatic injuries reflects the characteristics of the sport. The most common type of traumatic injury in our study was strain. This agrees with studies by Engstrom et al. (1991), Ostenberg and Roos (2000) and Soderman et al. (2001). We also found that the distribution between traumatic and overuse injuries differs during the football season. In our study the distribution of traumatic injuries occurred evenly during the entire season, with no apparent peak, which differs from that of the study of Engstrom et al. (1991) who showed a peak at the beginning of the competitive spring

period. The reason for this could be that injury patterns might have changed over the years as a result of differences in exposure to practice and game. The players, trainers, and medical personnel might also be better educated in preventing and taking care of traumatic injuries.

Overuse injuries seem to be more common during preseason and at the beginning of the spring season. These findings agree with Engstrom et al. (1991). The etiology of overuse injuries is more complicated as they depend on both intrinsic as well as extrinsic factors. These injuries might therefore need a more complex approach.

A high incidence of overuse injury to the spine was noted. Both changes of surface and weak trunk muscles in combination with hormonal fluctuations and premenstrual symptoms have been areas of discussion (Moller-Nielsen & Hammar, 1989, 1991; Brynhildsen et al., 1990, 1997a, b). Proper prevention programs such as special lower back and trunk stabilizing training programs might prevent these lower back pain problems. Prescription of contraceptive pills to reduce hormonal fluctuations and low back pain must take into account gynecological as well as ethical consideration.

Another of this study's findings was the high amount of re-injuries. Over half of the injured players reported an injury to the same body part occurring within 2 months of the initial injury. One out of four injuries was a re-injury at the same location, which is lower than that reported by Soderman et al. (2001). A re-injury could be a result of insufficient rehabilitation after an earlier injury. A hypothesis is that lack of knowledge about physical demands concerning female football games could be a reason for the high amount of re-injuries. Evidence-based physical tests to establish if the player is ready to go back into practice and game situations are needed. Even though most teams on this level have access to medical personnel, few of these personnel are present during all practices and games. A sports medicine trained physiotherapist, who is specialized in football medicine, could be valuable for the team during preseason training, for individual prevention programs, management of acute injuries as well as sport-specific rehabilitation of the player.

## References

Andreasen I, Fauno P, Lund B, Lemche P, Knudsen H. Football injuries among youth. *Scand J Med Sci Sports* 1992; 62-66.

Arendt E, Dick R. Knee injury patterns among men and women in collegiate basketball and football. *NCAA data*

and review of literature. *Am J Sports Med* 1995; 23: 694-701.

Aubry M, Cantu R, Dvorak J, Graf-Baumann T, Johnston K, Kelly J, Lovell M, McCrory P, Meeuwisse W, Schamasch P. Summary and agreement statement of the First International

Conference on Concussion in Sport, Vienna 2001. Recommendations for the improvement of safety and health of athletes who may suffer concussive injuries. *Br J Sports Med* 2002; 36: 6-10.

Backous DD, Friedl KE, Smith NJ, Parr TJ, Carpine WD Jr. Football injuries

## Conclusion

The present study shows that the knee is the most common location of injuries in elite female football players. One of five injuries is a major injury mainly owing to trauma, and localized to the knee. The high amount of head injuries during game time was notable. National team players, as well as players in the three highest ranked teams, were exposed to more playing hours during the year but did not differ in injury incidence from their counterparts. Injured players were found to have higher practice/game ratio than non-injured players.

## Perspectives

Further studies concerning the demands of female football as well as valid tests to establish if the player is physically and medically ready to return to game situations are needed. The high amount of re-injuries in our study emphasises this need.

The amount of traumatic head injuries is noticeably high. Protective helmets have now been introduced internationally and their effects need to be evaluated further.

Recent studies have shown that injury rate and distribution of injuries differ between genders, but the numbers of studies on female football players are still limited. The effect of age and playing level on incidence of injury is still unclear. The numbers of studies using the same method are limited. As a result, comparisons are hard to make. More studies with emphasis on age and playing level are needed in order to attain wider knowledge concerning injuries among female football players.

**Keywords:** soccer, sport injuries, women, injury incidence.

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- and their relation to physical maturity. *Am J Dis Child* 1988; 142: 839–842.
- Barnes BC, Cooper L, Kirkendall DT, McDermott TP, Jordan BD, Garrett WE Jr. Concussion history in elite male and female football players. *Am J Sports Med* 1998; 26: 433–438.
- Brynhildsen J, Ekstrand J, Jeppsson A, Tropp H. Previous injuries and persisting symptoms in female football players. *Int J Sports Med* 1990; 11: 489–492.
- Brynhildsen J, Lennartsson H, Klemetz M, Dahlquist P, Hedin B, Hammar M. Oral contraceptive use among female elite athletes and age-matched controls and its relation to low back pain. *Acta Obstet Gynecol Scand* 1997a; 76: 873–878.
- Brynhildsen JO, Hammar J, Hammar ML. Does the menstrual cycle and use of oral contraceptives influence the risk of low back pain? A prospective study among female football players. *Scand J Med Sci Sports* 1997b; 7: 348–353.
- Chomiak J, Junge A, Peterson L, Dvorak J. Severe injuries in football players. Influencing factors. *Am J Sports Med* 2000; 28: S58–S68.
- Dvorak J, Junge A. Football injuries and physical symptoms. A review of the literature. *Am J Sports Med* 2000; 28: S3–S9.
- Dvorak J, Junge A, Chomiak J, Graf-Baumann T, Peterson L, Rosch D, Hodgson R. Risk factor analysis for injuries in football players. Possibilities for a prevention program. *Am J Sports Med* 2000; 28: 69–74.
- Ekstrand J. Football injuries and their prevention. Medical dissertation no 130. Linköping University, Linköping, 1982.
- Ekstrand J, Gillquist J. Football injuries and their mechanisms: a prospective study. *Med Sci Sports Exerc* 1983; 15: 267–270.
- Ekstrand J, Gillquist J, Moller M, Oberg B, Liljedahl SO. Incidence of football injuries and their relation to training and team success. *Am J Sports Med* 1983; 11: 63–67.
- Ekstrand J, Karlson J. The risk for injury in football. There is a need for consensus about definition of the injury and the design of studies. *Scand J Med Sci Sports* 2003; 147–149.
- Ekstrand J, Walden M, Hagglund M. Risk for injury when playing in a national football team. *Scand J Med Sci Sports* 2004; 14: 34–38.
- Engstrom B, Forssblad M, Johansson C, Tornkvist H. Does a major knee injury definitely sideline an elite football player? *Am J Sports Med* 1990; 18: 101–105.
- Engstrom B, Johansson C, Tornkvist H. Football injuries among elite female players. *Am J Sports Med* 1991; 19: 372–375.
- Hagglund M, Walden M, Ekstrand J. Exposure and injury risk in Swedish elite football: a comparison between seasons 1982 and 2001. *Scand J Med Sci Sports* 2003; 13: 364–370.
- Hoff GL, Martin TA. Outdoor and indoor football: injuries among youth players. *Am J Sports Med* 1986; 14: 231–233.
- Inklaar H. Football injuries. I: incidence and severity. *Sports Med* 1994a; 18: 55–73.
- Inklaar H. Football injuries. II: aetiology and prevention. *Sports Med* 1994b; 18: 81–93.
- Janda DH, Bir CA, Cheney AL. An evaluation of the cumulative concussive effect of football heading in the youth population. *Inj Control Saf Promot* 2002; 9: 25–31.
- Junge A, Dvorak J. Influence of definition and data collection on the incidence of injuries in football. *Am J Sports Med* 2000; 28: S40–S46.
- Junge A, Dvorak J, Chomiak J, Peterson L, Graf-Baumann T. Medical history and physical findings in football players of different ages and skill levels. *Am J Sports Med* 2000; 28: S16–S21.
- Junge A, Rosch D, Peterson L, Graf-Baumann T, Dvorak J. Prevention of football injuries: a prospective intervention study in youth amateur players. *Am J Sports Med* 2002; 30: 652–659.
- Kibler WB. Injuries in adolescent and preadolescent football players. *Med Sci Sports Exerc* 1993; 25: 1330–1332.
- Lewis LM, Naunheim R, Standeven J, Laurysen C, Richter C, Jeffords B. Do football helmets reduce acceleration of impact in blunt head injuries? *Acad Emerg Med* 2001; 8: 604–609.
- Maehlum S, Dahl E, Daljord O. Frequency of injuries in a youth football tournament. *Physician Sportsmed* 1986; 14: 73–79.
- Matser JT, Kessels AG, Jordan BD, Lezak MD, Troost J. Chronic traumatic brain injury in professional football players. *Neurology* 1998; 51: 791–796.
- Matser EJ, Kessels AG, Lezak MD, Jordan BD, Troost J. Neuropsychological impairment in amateur football players. *JAMA* 1999; 282: 971–973.
- Moller-Nielsen J, Hammar M. Women's football injuries in relation to the menstrual cycle and oral contraceptive use. *Med Sci Sports Exerc* 1989; 21: 126–129.
- Moller-Nielsen J, Hammar M. Sports injuries and oral contraceptive use. Is there a relationship? *Sports Med* 1991; 12: 152–160.
- Naunheim RS, Ryden A, Standeven J, Genin G, Lewis L, Thompson P, Bayly P. Does football headgear attenuate the impact when heading a football ball? *Acad Emerg Med* 2003; 10: 85–90.
- Nilsson S, Roaas A. Football injuries in adolescents. *Am J Sports Med* 1978; 6: 358–361.
- Ostenberg A, Roos H. Injury risk factors in female European football. A prospective study of 123 players during one season. *Scand J Med Sci Sports* 2000; 10: 279–285.
- Peterson L, Junge A, Chomiak J, Graf-Baumann T, Dvorak J. Incidence of football injuries and complaints in different age groups and skill-level groups. *Am J Sports Med* 2000; 28: 51–57.
- Poulsen TD, Freund KG, Madsen F, Sandvej K. Injuries in high-skilled and low-skilled football: a prospective study. *Br J Sports Med* 1991; 25: 151–153.
- Roos H, Ornell M, Gardsell P, Lohmander LS, Lindstrand A. Football after anterior cruciate ligament injury – an incompatible combination? A national survey of incidence and risk factors and a 7-year follow-up of 310 players. *Acta Orthop Scand* 1995; 66: 107–112.
- Schmidt-Olsen S, Jorgensen U, Kaalund S, Sorensen J. Injuries among young football players. *Am J Sports Med* 1991; 19: 273–275.
- Soderman K, Adolphson J, Lorentzon R, Alfredson H. Injuries in adolescent female players in European football: a prospective study over one outdoor football season. *Scand J Med Sci Sports* 2001; 11: 299–304.
- Tysvaer AT. Head and neck injuries in football. Impact of minor trauma. *Sports Med* 1992; 14: 200–213.
- Tysvaer AT, Lochen EA. Football injuries to the brain. A neuropsychologic study of former football players. *Am J Sports Med* 1991; 19: 56–60.