Sports Med 2004; 34 (13): 929-938
0112-1642/04/0013-0929/$31.00/0

Soccer Injuries
A Review on Incidence and Prevention

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Contents

Abstract

Several investigators have studied the incidence and causes of soccer injuries in male professional players; however, epidemiological data on injuries in female soccer players are limited. From the data presented, it can be estimated that, on average, every elite male soccer player incurs approximately one performance-limiting injury each year. Nine studies on the prevention of soccer injuries were found in the literature. There is some evidence that multi-modal intervention programmes result in a general reduction in injuries. Ankle sprains can be prevented by external ankle supports and proprioceptive/coordination training, especially in athletes with previous ankle sprains. With regard to severe knee injuries, the results of prevention studies are partly inconclusive; however, training of neuromuscular and proprioceptive performance as well as improvement of jumping and landing technique seem to decrease the incidence of anterior cruciate ligament injuries in female athletes. Prevention programmes are likely to be more effective in groups with an increased risk of injury. More methodologically well-designed studies are required to evaluate the effects of specific preventive interventions.

Soccer, or football as it is officially called by the Fédération International de Football Association (FIFA), is the most popular sport in the world with approximately 200 000 professional and 240 million amateur players. The incidence of soccer injury has been investigated in several studies and varies substantially depending on the definition of injury, the characteristics of the investigated players and the research design.[1,2] The methodological problems associated with sports injury research have been described in detail by Finch,[3] Junge and Dvorak[4] and Noyes et al.[5]

Several investigators have described risk factors for soccer injuries and discussed possibilities for prevention,[6-9] but only a few have investigated the actual effectiveness of preventive interventions.[10-19] However, methodologically sound studies of injury prevention programmes are rare in all types of sport.[20]

A theoretical framework for the prevention of sports injury[21] proposes a four-step series (figure 1):

- step 1: establishing the extent of the sports injury problem;
- step 2: establishing the aetiology and mechanisms of injuries;
- step 3: introducing preventive measures;
- step 4: assessing the effectiveness of the preventive interventions by repeating step 1.

The present review on incidence and prevention of soccer injuries is structured following this sequence.

1. Incidence of Soccer Injury

In reviewing the literature on the exposure-related incidence of soccer injuries, the majority of studies focus on adult male professional players during the year (see table I). The highest incidences of injury were reported for players in the professional league of the US[22] and the national division league of Iceland,[23] whilst the lowest incidences were for Dutch[24] and Danish[25] low-level players. The incidence of match injuries is, on average, 4–6 times higher than the incidence of injuries that occur during training sessions. Some investigators have analysed the incidence of match injuries based only on reports[26-29] from team physicians or physiotherapists or from video recordings.[27,30-32] From the data presented, it can be estimated that, on average, every elite male soccer player incurs approximately one performance-limiting injury each year.[1,33]

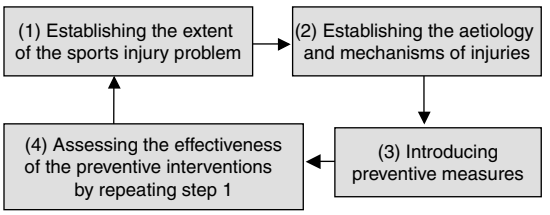

Fig. 1. Sequence of prevention (reproduced from van Mechelen et al.,[21] with permission).

Only a few studies have analysed the incidence of injuries in female soccer players.[44,45,47,50] Because of the limited database and methodological problems such as differences in the definition of injury, study design and characteristics of players, it cannot be deduced whether the overall incidence of injury differs between male and female players. Two studies that analysed injuries during soccer tournaments reported a higher incidence in men than in women.[26,51] However, some types of injury, such as anterior cruciate ligament (ACL) injuries, are more frequent in female than male athletes.[52,53]

For youth players, the incidence of injuries seems to increase with age;[24,37,47-49,54] the 17- to 18-year-old age group appears to have a similar or even higher incidence of injuries than adults.[24,37] The same observation was reported in a survey of injuries during 12 international tournaments for players of different age- and skill-level.[26]

2. Characteristics and Causes of Soccer Injuries

Excellent information on the characteristics and causes of soccer injuries in male professional soccer players has been presented by Hawkins et al.[33] who analysed a total of 6030 injuries in 91 English professional soccer clubs. There are little epidemiological data available regarding injuries to female players.[44,45,47] Summarising the literature, soccer injuries predominately affect the ankle, knee joints and the muscles of the thigh and calf. The most common types of injuries are sprains, strains and contusions.

The majority of soccer injuries are caused by trauma; between 9%[23] and 34%[25] of all injuries during the season are classified as overuse injuries. An important cause of soccer injuries is contact with another player and 12%[38] to 28%[55] of all injuries are attributed to foul play. During a major international tournament this proportion is even higher.[26,56] The percentage of non-contact injuries varies from 26%[39] to 59%.[38] Non-contact injuries occur mainly during running and turning.[33,38]

Table I. Incidence of injury in soccer players during a year or season

Study	Country	No. of players	Skill level	Age (y)	Study period	Injuries per 1000 hours		
						match	match and training	training
Male players								
Arnason et al.[34]	Iceland	306	National elite, first league	16–38	1 season (May–Sep 1999)	24.6		2.1
Ekstrand et al.[35]	Sweden	1 team	Senior national team		1991–97	30.3		6.5
Hägglund et al.[36]	Sweden	310	National top division	17–38	1 season (Jan–Oct 2001)	25.9		5.2
Morgan and Oberlander[22]	US	237	Major league soccer (professional)	18–38	1 season (Mar–Oct 1996)	35.5		2.9
Peterson et al.[37]	Czech Republic	21	1st, 2nd national league	>18	1y	18.9		
		30	3rd national league			10.2		
		17	Amateur teams			21.6		
		16	Local teams			29.7		
Hawkins and Fuller[38]	UK	108	Premier, 1st, 2nd professional league		3 seasons (Nov 1994–May 1997)	25.9		3.4
Arnason et al.[23]	Iceland	84	National division league	18–34	1 season (May–Sep 1991)	34.8		5.9
Inklaar et al.[24]	The Netherlands		Non-professional	19–60	1 season (Feb–Jun 1987)			
		101	High level			21.7		
		144	Low level			11.7		
Lüthje et al.[39]	Finland	263	Highest national league	17–35	1 season (May–Oct 1993)	16.6		1.5
Poulsen et al.[40]	Denmark	19	Division 1 (high)	21–28	1986	19.8		4.1
		36	Series 3 and 5 (low)	24–30		20.7		5.7
Engström et al.[41]	Sweden	64	1st, 2nd division, semi-professional	24 (mean)	1 season	13		3
Ekstrand and Tropp[42]	Sweden	135	Division 1 (high)	17–38	1y	21.8		4.6
		180	Division 2			18.7		5.1
		180	Division 4			16.9		7.6
Ekstrand et al.[43]		144	Division 6 (low)		1980	14.6		7.5
Nielsen and Yde [25]	Denmark	34	2nd division (high)	>18	1 season	18.5		2.3
		59	Series (low)		Jan–Nov 1986	11.9		5.6

Continued next page

Table I. Contd

Study	Country	No. of players	Skill level	Age (y)	Study period	Injuries per 1000 hours		
						match	match and training	training
Female players								
Östenberg and Roos[44]	Sweden	123	Senior players, different skill level	14–39	1 season (1996)	14.3		3.7
Engström et al.[45]	Sweden	41	Premier, 2nd division	16–28	1y	24		7
Youth/adolescent								
Junge et al.[46]	New Zealand	145	Schoolboy	14–18	Mar–Aug 2001	16.2		3.7
Junge et al.[15]	Switzerland	46	High-level male youth	14–19	1999–2000	18.7		4.1
		47	Low-level male youth		1y	21.7		8.2
Söderman et al.[47]	Sweden	42	Female adolescent	14–15	Apr–Oct 96		5.1	
		44		15–16			7.6	
		34		16–17			9.0	
		33		17–19			5.2	
Petersen et al.[37]	Czech Republic	70	High-level male youth	14–16	1y	15.8		
		23	Low-level male youth	14–16		37.8		
		65	High-level male youth	16–18		18.9		
		22	Low-level male youth	16–18		42.5		
Inklaar et al.[24]	The Netherlands	75	Male adolescent	13–14	Feb–Jun 1987	12.8		
		78		15–16		16.1		
		79		17–18		28.3		
Schmidt-Olsen et al.[48]	Denmark	247	Male adolescent	12–13	1y		3.4	
		112		14–15			3.8	
		137		16–17			4.0	
Yde and Nielsen[49]	Denmark	152	Male adolescent	6–18	Feb–Oct 1986		5.6	
Nielsen and Yde[25]	Denmark	30	Male youth	16–18	Jan–Nov 1986	14.4		3.6
Sullivan et al.[50]	US	931	Male adolescent	7–18	Spring season (1979)		0.5	
		341	Female adolescent				1.1	

Table II. The 'SportSmart' programme of the New Zealand Accident Compensation Corporation (reproduced from New Zealand Accident Compensation Corporation,[57] with permission)

Point	Action
1. Screening	Assessing health and fitness before playing identifies injury risk
2. Warm-up, cool down and stretch	The right preparation for mind and body makes for a better performance. Cooling down helps your body to recover and is a good time to work on flexibility
3. Physical conditioning	Staying in condition means playing to your maximum potential
4. Technique	Know how to play it safe with good technique
5. Fair play	Good sport is about positive attitude – playing fair and enjoying the game
6. Protective equipment	Protect yourself against injury by using the right equipment
7. Hydration and nutrition	Eating the right food and drinking adequate fluid helps maintain health and sports performance
8. Injury reporting	Gathering information about injuries and monitoring how and when they occur help in injury prevention – and improve the game for everyone
9. Environment	It is not only the weather that counts – safe surroundings means safer play
10. Injury management	Getting the right treatment sooner means less pain and a faster recovery

Approximately 20–25% of all injuries are re-injuries of the same type and location.[23,25,38] The importance of previous injuries and inadequate rehabilitation as risk factors for future injury has been described by Dvorak et al.,[6] Inklaar,[8] Hawkins et al.[33] and Arnason et al.[34]

Because of the limited information on injuries in female soccer players, it cannot be stated as yet whether or not the characteristics and causes of injuries vary substantially from those previously reported for male players.

3. Possibilities for Preventing Soccer Injury

Several authors have discussed possibilities for prevention of a soccer injury such as:

- warm-up with more emphasis on stretching;
- regular cool-down;
- adequate rehabilitation with sufficient recovery time;
- proprioceptive training;
- protective equipment;
- good playing field conditions;
- adherence to the existing rules.[15]

These topics are closely related to the 10-point action plan to avoid sports injury proposed by the SportSmart programme of the New Zealand Accident Compensation Corporation (table II).[57]

4. Studies on Prevention of Soccer Injuries

Preventive programmes generally focus either on the reduction of all injuries associated with a given sport or on a particular type of injury that is extremely severe or frequent. With respect to soccer, three studies have focused on the prevention of injuries in general[12,13,15] and seven others have evaluated the prevention of specific types of injury, namely ankle sprains,[17-19] severe injuries of the knee[11,14,16,17] and hamstring strains[10] (table III).

4.1 Prevention of Soccer Injuries in General

About 20 years ago, Ekstrand et al.[12] evaluated an injury prevention programme in male senior division players. Six out of 12 teams were randomised into an intervention group. The prevention programme included: the correction of training; provision of shin guards and during winter training special training shoes; prophylactic ankle taping in players with clinical instability or history of previous strain; controlled rehabilitation; exclusion of players with serious knee instability; information about the importance of disciplined play and the increased risk of injury at training camps; and correction and supervision of doctors and physiotherapists. During the 6-month follow-up period, the players in the intervention group sustained 75% fewer injuries than those in the control group.

Table III. Studies on the prevention of injury in soccer players

Study	Country	Intervention group	Control group	Sex	Age (y)	Type of injury	Intervention	Result
Ekstrand et al.[12]	Sweden	6 teams	6 teams	M	17–37	All time-loss injuries	Multi-modal intervention programme	Fewer injuries in the intervention than in the control group
Heidt et al.[13]	US	42 players	258 players	F	14–18	All time-loss injuries	Frappier Acceleration Training Program	Significantly lower incidence of injury in the trained than in the untrained group
Junge et al.[15]	Switzerland	101 players	93 players	M	14–19	All injuries	Multi-modal intervention programme	Fewer injuries in the intervention than in the control group
Tropp et al.[19]	Sweden	60 players and 65 players with previous ankle problems	171 players	M	Senior	Ankle sprains	Use of orthosis or ankle disk training	Both techniques reduce the frequency of ankle sprains in players with previous ankle problems
Surve et al.[18]	South Africa	117 players without and 127 players with previous ankle sprains	260 players	M	Senior	Ankle sprains	Instruction to wear a semi-rigid orthosis on the previously sprained ankle or on the dominant ankle	A semi-rigid orthosis significantly reduced the incidence of recurrent ankle sprains in players with previous history of ankle sprains
Söderman et al.[17]	Sweden	62 players	78 players	F	21 (mean)	Traumatic time-loss injuries of the lower extremities	Balance board training	No preventive effect on severe knee injuries or ankle sprains
Caraffa et al.[11]	Italy	40 teams	20 teams			ACL injuries	Proprioceptive training	Significant reduction of ACL injuries
Hewett et al.[14]	US	97 players	193 players	F	High-school age	Serious knee injuries	Pre-season neuromuscular training programme	A trend towards a higher incidence in the untrained group than in the trained group
Askling et al.[10]	Sweden	15 players	15 players	M	25 (mean)	Hamstring strains	Training with eccentric overload	Fewer injuries in the training than in the control group

ACL = anterior cruciate ligament; **F** = females; **M** = males.

In a more recent research project,[13] the effects of a pre-season conditioning programme on the occurrence of injuries were studied in 300 female high-school players aged 14–19 years. Out of the total group, 42 players were randomly selected to participate in the Frappier Acceleration Training Program for 7 weeks prior to the beginning of the season. The training programme combined sport-specific cardiovascular conditioning, plyometric work, sport-cord drills, strength training, and flexibility exercises to improve speed and agility. During the 1-year observation period, the untrained group had a significantly higher incidence of injury (34%) compared with the trained group (14%).

In a prospective controlled intervention study, Junge et al.[15] investigated whether the incidence of soccer injuries in male youth players could be reduced by education and supervision of players and coaches. Seven teams took part in the prevention programme, while seven teams of the same age and skill levels were instructed to train and play soccer as usual. The prevention programme included general interventions, such as appropriate warm-up, taping of unstable ankles, adequate rehabilitation and promotion of the spirit of fair play as well as exercises to improve the stability of ankle and knee joints, the flexibility and power of the trunk, hip and leg muscles, coordination, reaction time and endurance. The coaches were educated and supervised through courses, practical demonstrations and individual consultations given by a sports scientist. During the 1-year study period, the teams of the intervention group were looked after by a physiotherapist who attended one training session per week and supervised the warm-up, cool-down, performance of previously described exercises and rehabilitation of injured players. The incidences of injury per 1000 hours of training and playing soccer were 6.7 in the intervention group and 8.5 in the control group, which equates to 21% fewer injuries. The greatest effects of the intervention were seen for mild injuries, overuse injuries and injuries incurred during training. Low-level teams benefited more from the prevention programme than those of a high skill level.

The three studies on the prevention of soccer injury vary substantially in the characteristics of players, the duration of the interventions and the content of preventive programmes. However, all demonstrated a reduction in the incidence of injury in the intervention group compared with the control group. It remains unclear which aspect of the intervention programme contributed to the positive results because of the dissimilarity of the studies.

4.2 Prevention of Knee Injuries

The prevention of knee injuries in soccer players was investigated in three studies.[11,14,17] Caraffa et al.[11] analysed the effects of proprioceptive training on the incidence of ACL injuries in 40 semi-professional and amateur teams. While the teams of the control group were asked to train as usual, the intervention group received a special proprioceptive training programme of increasing difficulties in addition to their standard training. The players were instructed to train at least 20 minutes per day during the pre-season training and at least three times a week during the season. Over the three-season observation period, the incidence of ACL injuries was significantly lower in the intervention group (0.15 injuries per team/season) compared with the control group (1.15 injuries per team/season).

Hewett et al.[14] investigated the effects of a neuromuscular programme on the incidence of knee injuries in female soccer, volleyball and basketball players. Coaches and trainers from 12 area high schools were sent an instructional video and training manual demonstrating the training programme that incorporated flexibility, plyometrics and weight training to increase muscular strength and decrease landing forces. Fifteen teams (366 girls including 97 soccer players) participated in the 6-week pre-season neuromuscular programme and 15 teams (463 girls including 193 soccer players) did not. The incidence of serious knee injuries monitored over an entire season was significantly lower in the trained group (0.43 per 1000 player exposures) than in the untrained group (0.12 per 1000 player exposures). For soccer players only, a trend towards a higher incidence in the untrained group (0.56 per 1000

player exposures) than in trained group (0 per 1000 player exposures) was observed.

A large, but not yet published study on the prevention of ACL injuries in 14- to 18-year-old female soccer players also showed a significant reduction of injuries in the intervention group compared with an age- and skill-matched control group.[16]

Söderman et al.[17] analysed the effects of balance board training in female players from the second and third national division. Seven teams were randomised to an intervention group and six to a control group. The players of the intervention were given a balance board and a printed handout describing the programme and were instructed to perform the exercises at home in addition to their standard training. The programme consisted of five exercises with progressively increasing degrees of difficulty and were performed initially each day for 30 days and then three times a week for the rest of the season. The players were asked to record the amount of balance board training in a special protocol. Twenty-seven players of the intervention group were excluded because they performed <35 balance board sessions. Comparison of the intervention and control groups showed no significant differences with respect to the incidence of traumatic injuries of the lower extremities in general, severe knee injuries or ankle sprain.

In a recent review of 13 studies on the prevention of knee injuries in sports,[58] the investigators concluded that structured training programmes that emphasised neuromuscular and proprioceptive training offer encouraging evidence for the prevention of knee injuries.

4.3 Prevention of Ankle Sprains

Interventions to reduce the incidence of ankle sprains in soccer players have been evaluated in three studies.[17-19] Tropp et al.[19] compared the preventive effect of ankle disk training and use of orthoses in 25 male senior football teams followed up for 6 months. The teams were divided into three groups: (i) 60 players who used orthoses; (ii) 65 players with previous ankle problems who took part in a coordination training programme performed on an ankle disk; and (iii) 171 players who served as controls. Both interventions reduced the incidence of ankle sprains among players with a history of related problems to the same level as among players without any such history. The authors proposed the use of orthoses during the rehabilitation period, but also state that ankle disk training should be the method of choice in players with previous problems to prevent functional instability and recurrent ankle sprains.

Surve et al.[18] studied the preventive effect of a semi-rigid orthosis on the incidence of recurrent ankle sprains in male senior soccer players with and without previous ankle sprains during one playing season. Both groups were divided into an intervention and a control group. The players in the intervention group were provided with the orthoses and were instructed to wear them on the previously sprained or the dominant ankle. Compliance was strictly monitored by the coaches. The study showed that a semi-rigid orthosis had no effect in players without previous ankle sprains, but significantly reduced the incidence of ankle sprains in the players with a history of previous ankle sprains.

Reviews on the prevention of ankle sprains have similar results.[59-62] A recent Cochrane review[62] of interventions for preventing ankle ligament injuries concluded, from 14 randomised trials, that external ankle support in the form of semi-rigid orthoses or aircast braces can prevent ankle sprains during high-risk sporting activities such as soccer, especially in athletes with previous ankle sprains. Participants with a history of previous sprains should be advised that wearing such supports reduces the risk of incurring a future sprain. From other interventions aimed specifically at the prevention of ankle sprains, proprioceptive/coordination training using ankle disks seems to be the most promising.

5. Conclusions

Summarising the scientific literature on the incidence of soccer injuries, it can be estimated that on average every elite male soccer player incurs approximately one performance-limiting injury each year. For female players, only little epidemiological

data on injuries are available. Studies on the prevention of soccer injuries vary substantially in characteristics of the study population and the type of interventions. However, there is some evidence that multi-modal intervention programmes result in a reduction in injuries in general. Proprioceptive or neuro-muscular training seems to prevent severe knee injuries and recurrent ankle sprains. The use of semi-rigid orthoses should be recommended for players with previous ankle sprains. However, more methodologically well-designed studies are required to evaluate the effects of specific preventive interventions. Future studies should monitor compliance with the programme because this is an essential factor for its effectiveness. Prevention programmes probably have different effects in male and female players, and are more effective in groups with an increased risk of injury. Identification of high-risk groups may help to limit the cost and improve the effects of sports injury prevention programmes.

Acknowledgements

The authors gratefully acknowledge FIFA (Fédération Internationale de Football Association) for the funding of this study. The authors have no conflicts of interest that are directly relevant to the content of this review.

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