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Incidence of Soccer Injuries among 15- to 19-Year-Old Boys in Norwegian National Teams

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Abstract

Purpose: The incidence of soccer-related injuries among young players has not yet been registered in Norway. It is important to find out which injuries are most frequent on each level and how we can best prevent these injuries. The purpose of this study was to examine which injuries 15-, 17-, and 19-year-old male soccer players are exposed to.

Methods: A descriptive epidemiologic study. Male soccer players aged 15, 17, and 19 years were asked to complete a questionnaire covering their injuries in the last two years. These players were all on the national teams in Norway.

Results: Among the 15-year-old boys, 51% reported acute ankle sprains, 50% acute groin pain, 36% acute knee pain, and 29% acute hamstring injuries. Fifty-four percent reported one or more overuse injuries. Among the 17-year-old boys, 55% reported acute ankle sprains, 35% acute groin pain, 30% acute knee pain, and 28% acute hamstring injuries. Sixty percent reported one or more overuse injuries. Among the 19-year-old boys, 52% reported acute ankle sprains, 39% acute knee pain, 29% acute groin pain, and 10% acute hamstring injuries. Sixty-eight percent reported one or more overuse injuries.

Conclusion: This study indicates that 15-, 17-, and 19-year-old boys playing for the Norwegian national teams have many overuse injuries. Ankle sprain is the most commonly reported acute injury. The high incidence of injuries in these players highlights the need for education and prevention programs in youth soccer.

Keywords

Injuries; Football; Young players; Epidemiology

Introduction

Soccer is one of the most popular sports worldwide, with FIFA recognizing more than 265 million amateur players [1]. Most players are younger than 18 years of age. United States high school soccer participation increased five-fold over the last 30 years, and soccer is the fastest-growing team sport in the U.S. [1]. The interest in soccer continues to increase, even within younger age groups participating at a competitive level. Despite the fact that soccer is a contact sport, it is perceived to be relatively safe to play. In addition, playing soccer can induce several beneficial health effects. However, soccer poses the risk of injuries. Next to American football and wrestling, soccer had the highest high school sports injury rate in the U.S. during the 2005–2006 season [2]. It is necessary to implement measures for preventing injuries. Accordingly, appropriate rule enforcement and emphasis on safe play can reduce the risk of soccer-related injuries [3].

A Danish study showed that boys aged 12-18 had 3.7 injuries per 1000 hours of soccer play [4]. The incidence increased with age, and the oldest players approached the incidence rate of senior players. The conclusion was that youth soccer is a relatively low-risk sport [4]. A similar study from Sweden reported that injury incidence was 2.4 injuries per 1000 game hours [5]. They concluded that soccer is a suitable sport to keep children active and that injury programs should be provided. In Norway, 233,200 boys (30%), 13 to 19 years old, played organized soccer in 2011 [6]. There was only one registration of soccer-related injuries in this age group in Norway although in 2005-2007, injuries were registered at the Norway Cup Tournament [7]. While these youth soccer studies have been conducted, no studies have been made for young boys playing soccer at the highest competitive level.

Ankle sprain is an extremely common injury in young soccer players, and a single intrinsic cause remains unclear [3]. Functional strength asymmetries of the ankle flexors, an increased body mass index, and an increased body weight raise the propensity for ankle sprains in professional soccer players [8]. Joint hypermobility seems to be a risk factor for ankle sprains and knee injuries among professional players in an English Premier League club [9]. These findings suggest a need for routine screening of hypermobility among young individuals.

The majority of teams in the Premier League in England have developed their own soccer academies. They believe that these young athletes have a high risk of injury, and they have implemented prevention programs to minimize this risk. The injury incidence at the academy level is approximately half of what it is in the Premier League [10]. Nevertheless, it is important to implement additional strategies to reduce the number of injuries encountered at this level. In the Newcastle United Soccer Academy, it was concluded that the relative risk of injury was highest in the 15 and older age groups [11]. In United States high school soccer, the injury patterns vary by gender and type of exposure. The most frequent diagnoses were incomplete ligament sprains (26.8%), incomplete muscle strains (17.9%), contusions (13.8%), and concussions (10.8%). The most commonly injured body sites were ankles (23.4%), knees (18.7%), head/face (13.7%), and thigh/upper leg (13.1%) [12-23].

Knowledge of the injury pattern in soccer is important for everybody who works with young soccer players. This means mainly the coaches and the medical staff in the academies but also teachers and parents. There must be a high focus in preventing and minimizing injuries.

Most of the current knowledge comes from adult professional soccer players [12]. There is a lack of data in adolescents. In order to make and evaluate adequate prevention programs, prevalent

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information on adolescent injuries is needed. The aim of this study is to describe the injury incidence among high-level, 15-, 17-, and 19-year-old male soccer players in Norway.

Materials and Methods

Materials

The Regional Ethics Committee, Trondheim, Norway approved this study. All respondents gave their written consent to participate in the study after receiving written information. On behalf of the minors, parents or caretakers gave their written consent. The study was based on data from a questionnaire given to 15-year-old boys during a talent camp, which takes place every year. The 17- and 19-year-old groups answered the questionnaire either during matches with their national team, by e-mail, or by telephone. A physiotherapist was available if the subjects had any questions while answering the questionnaire. The data collection was made in 2007–2012. No personal identification was noted.

Subjects

There were 225, 135, and 65 players in the 15-, 17-, and 19-year-old groups, respectively, who participated in the study, totaling 425 respondents. The inclusion criterion was that players in recent years played on one of the three national teams and were therefore competing at the highest level in Norway.

The questionnaire included the following data: (1) height, (2) weight, (3) years of soccer experience, (4) position played, (5) level played last season and this season, (6) training hours per week, and (7) hours in matches per week. Medical information from the last two years included the following: acute injuries in the (1) ankles, (2) knees, (3) hamstrings, (4) groin, and (5) other body sites and overuse injuries due to (1) shin splints, (2) Mb Schlatter (inflammation in the patellar ligament), (3) tendinopathy in the Achilles tendon, and in the (4) other body sites. The questionnaire also included (1) amount of time since last injury occurrence and (2) number of days absent from training or matches.

Injury definitions: An acute injury is a sudden injury that leads to absence from training or matches for at least one day. An overuse injury is a gradual onset of pain that leads to absence from training and matches for at least one day.

Statistics

Data are presented as the number of acute and overuse injuries according to all three age groups and the number of training hours. Injury incidence (injuries incurred per 1000 training hours) was used to compare injury incidence among the different age groups, and 95% confidence intervals were calculated for estimates of injury incidence. In each age group, only one injury was accounted for each player in order to avoid intra-player dependence, i.e., multiple injuries in individual players. The more significant injury was the one that was included. The statistical analyses were performed using Stata Version 12.0 (StataCorp).

Results

Compliance for the 15-year-old group was 100%, while compliance for the 17- and 19-year-old groups was 90%. Sixty-five percent of the players had a chronic injury during the last two years. Many of these players had lost time in training and in matches for more than four weeks.

The total exposure to training corresponded to 325,680 training hours during a year (46 weeks). In total, 377 acute injuries were recorded, corresponding to 1.15 injuries per 1000 player training hours (Table 1). The acute injury incidence recorded among 15-year-old players was 1.17 injuries per 1000 player training hours. The incidence of acute injuries per 1000 player training hours was 1.14 (1.06–1.23) and 1.15 (0.99–1.31) among 17- and 19-year-old players, respectively. The individual region's figures do account for multiple injuries per player. The most common types of acute injuries were ankle sprains (180 injuries) and groin pain (141 injuries).

Among all subjects, the incidence of chronic injuries was 0.74, 95% CI [0.68, 0.81], per 1000 hours of exposure (Table 2). There were no differences in the incidence of chronic injuries among the three different age groups. The most common chronic injuries were due to Mb Schlatter disease (0.17, 95% CI [0.12, 0.21], per 1000 hours of exposure). Furthermore, younger boys playing in higher divisions have had more acute injuries (Tables 3 and 4).

Discussion

The main finding of this study was that the incidence of acute injuries was higher than overuse injuries at all three age levels. Similar to the findings seen in previous research, ankle sprains are the most common acute injury [12,13]. In the present study, the incidence of ankle sprains was 0.55 injuries per 1000 hours of exposure (CI [0.49, 0.62]). The second most common acute injury, groin strain, was reported by 15-year-old players almost as often as ankle sprains.

*To avoid intra-player dependence (multiple injuries/re-injuries in individual players) in the analyses, only one injury was accounted for each player. The individual region's figures do account for multiple injuries per player
†Organized training hours in a year (46 weeks)
The small sub-tables at the top combine data over all age groups

Table 1: Acute injuries.

Injuries	Number	Total training (hours)	Incidence/1000 h (95% CI)
*Total	377	325 680	1.15 (1.10 to 1.21)
Ankle	180	325 680	0.55 (0.49 to 0.62)
Knee	98	325 680	0.30 (0.24 to 0.35)
Hamstring	88	325 680	0.27 (0.22 to 0.32)
Groin	141	325 680	0.43 (0.37 to 0.49)
Other	158	325 680	0.49 (0.42 to 0.55)

Age	Injuries	Number	Total training (hours)†	Incidence/1000 h (95% CI)
15	*Total	179	152 628	1.17 (1.08 to 1.25)
	Ankle	83	152 628	0.54 (0.45 to 0.64)
	Knee	49	152 628	0.32 (0.23 to 0.39)
	Hamstring	45	152 628	0.29 (0.22 to 0.37)
	Groin	80	152 628	0.52 (0.42 to 0.61)
	Other	72	152 628	0.47 (0.38 to 0.56)
17	*Total	148	129 444	1.14 (1.06 to 1.23)
	Ankle	76	129 444	0.59 (0.49 to 0.69)
	Knee	33	129 444	0.25 (0.18 to 0.33)
	Hamstring	35	129 444	0.27 (0.19 to 0.35)
	Groin	46	129 444	0.36 (0.27 to 0.45)
	Other	65	129 444	0.50 (0.40 to 0.60)
19	*Total	50	43608	1.15 (0.99 to 1.31)
	Ankle	21	43608	0.48 (0.30 to 0.66)
	Knee	16	43608	0.37 (0.21 to 0.53)
	Hamstring	8	43608	0.18 (0.06 to 0.31)
	Groin	15	43608	0.34 (0.19 to 0.50)
	Other	21	43608	0.48 (0.30 to 0.66)

*To avoid intra-player dependence (multiple injuries/re-injuries in individual players) in the analyses, only one injury was accounted for each player. The individual region's figures do account for multiple injuries per player.
†Organized training hours in a year (46 weeks).
The small sub-tables at the top combine data over all age groups.

Table 2: Chronic injuries.

Injuries	Number	Total training (hours)	Incidence/1000 h (95% CI)
*Total	242	325 680	0.74 (0.68 to 0.81)
Achilles	21	325 680	0.06 (0.04 to 0.09)
Schlatter	54	325 680	0.17 (0.12 to 0.21)
Tibiaperiostitt	25	325 680	0.08 (0.05 to 0.11)
Other	178	325 680	0.55 (0.48 to 0.61)

Age	Injuries	Number	Total training (hours)†	Incidence/1000 h (95% CI)
15	*Total	110	152 628	0.72 (0.62 to 0.82)
	Achilles	12	152 628	0.08 (0.04 to 0.12)
	Schlatter	40	152 628	0.26 (0.19 to 0.34)
	Tibiaperiostitt	9	152 628	0.06 (0.02 to 0.10)
	Other	69	152 628	0.45 (0.36 to 0.54)
17	*Total	101	129 444	0.78 (0.68 to 0.88)
	Achilles	8	129 444	0.06 (0.02 to 0.10)
	Schlatter	14	129 444	0.11 (0.05 to 0.16)
	Tibiaperiostitt	13	129 444	0.10 (0.05 to 0.15)
	Other	80	129 444	0.62 (0.52 to 0.72)
19	*Total	31	43608	0.71 (0.52 to 0.90)
	Achilles	1	43608	0.02 (-0.02 to 0.07)
	Schlatter	0	43608	0
	Tibiaperiostitt	3	43608	0.07 (-0.01 to 0.15)
	Other	29	43608	0.67 (0.47 to 0.86)

Descriptive table of acute injuries related to level of playing and age
*Higher than fourth level for adults in the Norwegian division system

Table 3: Level of playing and acute injuries.

Age	Injuries	Level of playing and number of injuries				Total
	Ankle	Boys	Junior	>3 div*	≤3 div*	
15		15	41	23	3	82 of 130 players
17		0	4	44	28	76 of 208 players
19		0	0	4	17	21 of 135 players
	Knee					
15		7	26	16	0	49 of 130 players
17		0	1	21	11	33 of 208 players
19		0	0	4	12	16 of 135 players
	Hamstrings					
15		10	19	14	2	45 of 130 players
17		0	0	25	10	35 of 208 players
19		0	1	2	5	8 of 135 players
	Groin					
15		15	35	26	3	79 of 130 players
17		0	4	29	13	49 of 208 players
19		0	2	4	9	15 of 135 players
	Other					
15		13	38	18	3	72 of 130 players
17		1	4	36	24	65 of 208 players
19		0	2	6	13	21 of 135 players

Furthermore, many players reported groin pain as the most common overuse injury. Serious diagnoses, such as osteitis pubis and overuse fractures in the pelvic area, were also reported. These injuries resulted in several weeks of time loss from training and matches.

Faude et al. [12] reported from a literature search that training injury incidence was nearly constant for players aged 13–19 years, ranging from one to five injuries per 1000 hours of training. Match injury incidence tended to increase with age throughout all age groups, with an average incidence of 15 to 20 injuries per 1000 match hours in players older than 15 years. Between 60% and 90% of all football injuries were classified as traumatic, and 10 to 40% were overuse injuries. Most injuries (60 to 90%) were located in the lower extremities, with the ankle, knee, and thigh being mostly affected [12]. Injury rates were higher in soccer games than during training, and the incidence of injury tended to increase with grade level [14]. Malina et al. [14] reported that age, height, body mass index (BMI), and maturity status were not related to the risk of injury. In another study on male soccer players with a mean age of 14.7 +/- 2.1 years, taller players reported more injuries than shorter players (62.5% versus 37.5%, respectively) [15]; however, the proportion of "shorter" to "longer" players remains unclear. Injuries were more frequent among players with a training duration greater than five years (69.6%) in comparison to those who trained for a shorter duration (30.3%). The ankle or foot and the knee were the most affected anatomic sites, and impact was the most common mechanism of injury [15].

The lower limb injuries may be explained by maturity. Maturity is the difference between chronological age and skeletal age, and there can be big differences in bone and muscle strength for boys between the ages of 15 and 17. It is likely to think that late maturity (skeletal age of more than one year below chronological age) is more exposed to overuse injuries than early maturity (skeletal age of more than one year above chronological age). Maturity plus training and playing hours together predict injury in soccer players [16]. For thigh muscle strains, a study from Italy showed that previous injuries, as well as stature, were significantly correlated to thigh-strain survival probability [17].

Most people active in sports at this high level will, sooner or later, suffer from an acute or chronic injury. The impact of the data in this present study is likely to be good as the players are followed over several years. In addition, the injury incidence among all players at this age range is not known. Therefore, the present results might provide a good basis in future prevention program studies.

Most adolescent Norwegian soccer players are frequently training and playing matches on artificial turf. The new-generation artificial turf is the most-used playing surface for soccer playing fields, especially in the preseason. Natural grass has become gradually less used. Can this factor explain the overuse injuries? Many prospective studies show no significant difference between natural grass and artificial turf play for acute injuries incurred during training and matches [18,19] although Aoki et al. [20] reported that adolescents playing on artificial turf showed a significantly higher incidence of low-back pain during training compared to those who played on natural grass. Ekstrand et al. [21] made a comparison of injuries sustained on artificial turf and grass by male and female elite soccer players and found that 71% of the injuries were traumatic and 29% were overuse injuries. There were no significant differences in the nature of overuse injuries recorded on artificial turf and grass for either men or women. The study by Ekstrand et al. [21] was made for adult elite soccer players, and it may be that adolescent players are more sensitive to the playing surface than older players are.

Descriptive table of chronic injuries related to level of playing and age
*Higher than fourth level for adults in the Norwegian division system

Table 4: Level of playing and chronic injuries.

Age (year)	Injuries	Level of playing and number of injuries				Total
	Achilles	Boys	Junior	>3div*	≤ 3div*	
15		2	8	2	0	12 of 130 players
17		0	1	6	1	8 of 208 players
19		0	0	1	0	1 of 135 players
	Schlatter					
15		7	15	18	0	40 of 130 players
17		0	0	9	5	14 of 208 players
19		0	0	0	0	0 of 135 players
	Tibiaperiostitt					
15		2	4	3	0	9 of 130 players
17		0	0	8	5	13 of 208 players
19		0	0	1	2	3 of 135 players
	Other					
15		14	31	22	2	69 of 130 players
17		0	3	41	36	80 of 208 players
19		0	2	6	21	29 of 135 players

In regards to footwear, young soccer players use various types of soccer shoes and studs. Studs made for natural grass or artificial turf may be used. These studs are either conventional or bladed. Conventional studded shoes for natural grass are longer and give the player a better grip on the playing surface as opposed to studs made for artificial turf. Studded soccer shoes can be considered safer than bladed shoes. Bladed shoes are more harmful due to their increased pressure under the lateral half of the foot, predisposing the foot to injuries [22]. Still, artificial studs are shorter and more numerous and divide the body weight over a larger surface. It is likely that artificial turf will be the most common playing surface in the future years in Norway.

In the present study, it was found that 15-year-old players had many more injuries playing at a senior level (> 20 years), compared to the players playing at a junior level (< 20 years). In our opinion, this is an important finding that needs to be discussed further in the soccer associations. Do they play too many matches at a high intensity instead of using the time for basic training? The Norwegian Football Association stopped a bill in 2012 that would have allowed 14-year-old boys to play adult soccer in the 3rd division and lower [22]. According to the present results, we think this is a step in the right direction to prevent musculoskeletal injuries in young athletes.

With the results from the present study in mind, there will hopefully be interest from the sport of soccer to address preventive actions. These young players have to pay attention and learn how to prevent serious injuries. More knowledge about preventative programs is needed, and more education for the trainers and medical staff might be necessary. It is not easy for talented young athletes to ask for rest when they feel symptoms of an overuse injury.

There is some evidence that the risk of traumatic injuries and, in particular, of sustaining a fracture, contusion, or concussion was higher during match play than in practice sessions [23]. Is it right to say, "If you are good enough in soccer, you are old enough to play"? Perhaps this is right when just assessing soccer-playing skill, but is it right for 15- to 19-year-old players to risk injury? From the results of the present study, we request soccer trainers and medical teams to discuss these questions in order to reduce the overall injury rate. Further studies should include injury prevention programs to increase the general knowledge of prevention factors, thereby better protecting young players from acute and chronic injuries.

Limitations

We were not able to adjust the incidence in regards to interruptions in training according to injuries, which meant the underestimation of the present injury ratio. A major limitation was the lack of a validity test for the questionnaire. Another major limitation was the retrospective design. All the results were self-reported, which is another major limitation. The confidence for the method in this study cannot be supported by previous studies, even though other similar studies have discussed the same limitations.

Conclusion

The high incidence of acute injuries highlights the need for education and prevention programs in youth soccer. There is not a high risk of chronic injuries. Acute injury incidence is, however, higher than chronic injuries, and in line with findings from previous research. We found that when a 15-year-old boy participates in a higher division, he is more likely to incur an injury. In conclusion, soccer training is safe in general and should be encouraged. However, care should be taken when allowing a younger player to play in a higher division.

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