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Injuries in Professional Male Soccer Players in the Netherlands: A Prospective Cohort Study

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Context: Injuries are a major adverse event in a soccer player's career. Reducing injury incidence requires a thorough knowledge of the epidemiology of soccer injuries.

Objective: To investigate the incidence and characteristics of injuries in the Dutch premier soccer league.

Design: Cohort study.

Setting: The Dutch premier soccer league.

Patients or Other Participants: During the 2009–2010 soccer season, a total of 217 professional soccer players from 8 teams were prospectively followed.

Main Outcome Measure(s): The medical staff recorded time-loss injuries, including information on injuries (ie, type, body part, duration) and exposure data for training sessions and matches.

Results: A total of 286 injuries were recorded, affecting 62.7% of the players. The overall injury incidence was 6.2 injuries per 1000 player-hours, 2.8 in training sessions and 32.8 in matches. Most of the recorded injuries were acute (68.5%). Eight percent of the injuries were classified as recurrent. Injuries were most likely to be located in the lower extremities (82.9%). Injury time loss ranged from 1 to 752 days, with a median of 8 days. Knee injuries had the greatest consequences in terms of days of absence from soccer play (on average, 45 days). The most common diagnosis was muscle/tendon injury of the lower extremities (32.9%).

Conclusions: Injury risk in the Dutch premier soccer league is high, especially during matches. Preventive measures should focus on the most common diagnoses, namely, muscle/tendon injuries of the lower extremities.

Key Words: football, incidence, epidemiology, elite athletes

Key Points

- Injury risk in the Dutch premier soccer league is high; during 1 season, 62.7% of the players sustained an injury.
- Injuries most often affected the lower extremities (groin, posterior thigh, knee, lower leg/Achilles tendon, and ankle).
- Recurrent injuries caused longer absences than did first-time injuries, and knee injuries had the greatest consequences in time lost from soccer play.
- Preventive measures should focus on the most common diagnoses, namely, muscle/tendon injuries of the lower extremities.

Soccer is the sport with the greatest participation globally.[1] More than 200 million people from 203 nations are members of the Federation of International Football Associations (FIFA), while the Union of European Football Associations (UEFA) has 23 million members in 51 countries.[2] Outdoor soccer was played by 2635 clubs and approximately 60 500 teams in the Netherlands during the 2011–2012 season. There are currently more than 1.2 million licensed members of the Royal Netherlands Football Association, 45% of whom are adult males.[3]

To obtain a good ranking in competition, soccer players have to be talented, well trained, and healthy, so injuries are a major adverse event in a soccer player's career. Medical and surgical treatment and rehabilitation interrupt the player's activity for a period ranging from a few weeks to several months.[2] If many injuries are sustained, team results can suffer.[4] Reducing the injury incidence and increasing player safety requires a thorough knowledge of the epidemiology of soccer injuries.[5] One major problem in the epidemiologic assessment of soccer injuries, however, is the methodologic inconsistency among studies. For example, injury definitions and methods for data collection and recording often differ considerably among studies.[6,7]

Investigations that describe injury risk and injury patterns in professional soccer have typically been conducted during tournaments,[8–11] have involved only teams at the highest European level,[10,12] have covered only part of a season,[13] or were related to only 1 team.[14,15] Limited published research has included data on injuries within 1 national professional male soccer competition and involving multiple teams. Hence, little is known about the differences among countries in injury risk and injury patterns in professional male soccer players. During the last 10 years, acute and

overuse injuries during matches and training sessions within national professional male soccer competitions have been recorded in Denmark[13] and Sweden.[16–18] In view of the differences in performance level, medical support, match frequencies, and climate, it is plausible that the incidence and severity of soccer injuries may differ between Scandinavian and other European soccer leagues.[18] Therefore, our study aimed to prospectively record injuries in the Dutch premier soccer league to investigate the incidence and characteristics of injuries in male professional soccer players during 1 entire soccer season.

METHODS

Male soccer players participating in the Dutch premier soccer league were prospectively followed during the 2009–2010 competitive season from July 31 through May 2 (39 weeks). Players who were injured at the start of the season, as well as players who left the team during the season, were included in the study; we took into account the time they spent on the team. Players who were still injured after May 2 were prospectively followed until they had recovered, so we could collect information about the duration of their injury. The players were informed about the study and agreed to participate by signing an informed consent form. Study design and procedures were in accordance with the Declaration of Helsinki, as well as the ethical standards of the *International Journal of Sports Medicine*.[19] The study protocol was approved by the ethics committee of the Netherlands Organization for Applied Scientific Research (TNO), and the study design was approved by the Science Committee of the EMGO Institute for Health and Care Research of VU Medical Center.

Within each club, 1 person was responsible for entering the data. This contact person was a member of the club's medical staff (physical therapist or team physician). At the start of the study, baseline characteristics of all players were recorded by the contact person, including information regarding age, height, body weight, playing position, years of experience as a professional soccer player, and soccer injuries lasting more than 1 week that were sustained during the previous year (number and body part affected). Individual training-session exposures were recorded by the contact person on a daily basis by using an Excel spreadsheet (version 2010; Microsoft Corp, Redmond, WA). Match exposure data were provided by Infostrada Sports (Nieuwegein, Utrecht, the Netherlands).

During the entire 2009–2010 season, all clubs participating in the Dutch premier soccer league were asked to systematically record the injuries sustained by their first team, using TNO's Web-Based Injury System.[20] This system was set up under the authority of the Dutch Ministry of Health, Welfare, and Sports to record information on injuries and recovery in 18 different types of sports. The data collection followed the international consensus statement on procedures for epidemiologic studies of football injuries recommended by FIFA and UEFA.[21,22] In agreement with the consensus statement by Fuller et al,[21] a *time-loss injury* was defined as "any physical complaint sustained by a player resulting from a soccer match or soccer training session and leading to the player being unable to fully take part in a soccer activity on the day after the injury." *Recovery* was defined as follows: "according to the medical staff, the player is capable of fully taking part in the regular training sessions or playing matches." The player has not recovered fully if any adjustment has to be made in the training program as a consequence of an injury.[21] The contact person also recorded epidemiologic information on injuries (eg, type, body part, duration) and factors related to an injury, such as contact with another player and weather conditions. For recurrent injuries, we used the following definition: "an injury of the same type and at the same site as an index injury and which occurs after a player's return to full participation from the index injury."[21] By the number of days of absence, injuries were categorized according to their severity: *minimal* (1–3 days), *mild* (4–7 days), *moderate* (8–28 days), *severe* (>28 days), and *career ending*.[21]

All statistical procedures were conducted using SPSS (version 20.0; IBM Corp, Armonk, NY). Baseline characteristics, measured as continuous variables, were calculated as mean values with corresponding standard deviations. Ordinal or categorical variables, such as injury severity and injury history, were presented as absolute numbers and percentages. Separate injury incidence rates were calculated for training and match exposure. Incidences were determined as the number of injuries per 1000 exposure hours, according to the formula $I = (n / e) \cdot 1000$, where n is the number of soccer injuries sustained during the soccer season and e, the total exposure time expressed as total hours of soccer participation. Corresponding 95% confidence intervals (CIs) were obtained using the Poisson model. We also calculated the percentage of acute injuries, percentage of recurrent injuries, body parts affected, diagnoses, and durations. In view of the skewed distribution, absenteeism was presented as the median and interquartile range (IQR). The IQR is equal to the difference between the upper and lower quartiles ($IQR = Q_3 - Q_1$). In the Discussion section, we compare the incidences in the Dutch soccer league with those in the Danish and Swedish leagues. This comparison is based on the 95% CIs.

RESULTS

All 18 Dutch premier league soccer clubs were invited to participate. Six clubs declined to participate (n = 149 players). Four clubs had to be excluded owing to missing exposure data (n = 129 players). The final sample consisted of 217 players from 8 teams. The mean ranking of the included teams at the end of the season was 7.8. The mean team size was 27 ± 3, ranging from 22 to 31 players. Baseline characteristics of the included players were as follows: age = 24.6 ± 4.3 years, height = 1.83 ± 0.07 m, body weight = 78.4 ± 7.5 kg, body mass index = 23.5 ± 1.6 kg/m^2, experience in professional soccer = 6.3 ± 4.2 years. Almost 40% of the soccer players (n = 85, 39.2%) reported at least 1 soccer injury that had lasted more than 1 week in the year before the study, and 14 players (6.5%) were injured at the start of the study.

During the season, the total exposure time was 46 194 hours (41 012 training session hours and 5182 match hours). The mean training-session exposure and match exposure per player were 189.0 ± 71.5 hours and 23.9 ±

Table 1. Factors Most Frequently Mentioned as Being Related to an Injury[a]

Contributing Factor	Soccer Injuries, No. (%), 280 (100)[b]
Contact with player	92 (32.9)
Jumping	33 (11.8)
Fatigue	32 (11.4)
Distorting	24 (7.1)
Turning/twisting	22 (7.9)
Contact with ball	18 (6.4)
Reaching (for ball)	17 (6.1)
Shooting	16 (5.7)
Other	16 (5.7)
Playing-field conditions	16 (5.7)
Fall	8 (2.9)
Artificial turf	6 (2.1)
Weather conditions	6 (2.1)
Unknown	55 (19.6)
None	3 (1.1)

[a] More than 1 answer could be given.
[b] Contributing factors are missing for 6 injuries.

21.6 hours, respectively, during the 39 weeks of the competition season.

In total, 286 time-loss injuries were sustained by 62.7% (n = 136) of the players. The overall injury incidence was 6.2 (95% CI = 5.5, 7.0) injuries per 1000 player hours, with a training incidence of 2.8 (95% CI = 2.3, 3.3) and match incidence of 32.8 (95% CI = 28.2, 38.1). The incidence of recurrent injuries was 0.5 (95% CI = 0.3, 0.7). A team sustained an average of 1.1 injuries per match. A total of 60 players (27.6%) sustained 1 injury, and 76 players (35.0%) sustained multiple injuries. Of the players sustaining multiple injuries, 40 players (18.4%) were injured twice during the season; 16 players (7.4%), 3 times; 11 players (5.1%), 4 times; and 9 players (4.0%), 5 times or more. Eight percent (n = 22) of the injuries were classified as recurrent. Sixty-four percent (n = 14) of these injuries occurred within 2 months of a player's return to full participation (*early recurrence*).

Most of the recorded injuries were acute (n = 196; 68.5%) and occurred during a match (n = 170; 59.4%). Factors most frequently mentioned as being related to an injury are stated in Table 1: the most common were contact with another player (n = 92; 32.9%), jumping (n = 33; 11.8%), and fatigue (n = 32; 11.4%).

Injuries were most likely to be located in the lower extremities (n = 237; 82.9%). The most often injured body parts (n = 285) were: knee (n = 61; 21.3%), thigh (posterior; n = 44; 15.4%), lower leg/Achilles tendon (n = 34; 11.9%), and ankle and groin (each n = 30; 10.5%). Affected body parts, injury types, and injury severities are listed in Tables 2 through 4. Body parts and injury types are cross-tabulated in Table 5. The most common diagnosis was lower limb muscle/tendon injury (n = 94; 32.9%), especially hamstrings (n = 38; 13.3%) and groin (n = 25; 8.3%).

Injury time loss ranged from 1 to 752 days, with a median of 8 days and an IQR of 12. Recurrent injuries caused longer absences (median = 10.5 days, IQR = 12) than first-time injuries (median = 7 days, IQR = 12.5). Knee injuries had the greatest consequences in terms of absence from soccer play: the rehabilitation of a knee injury took an average of 45 days (median = 10 days, IQR = 30). Fifteen

Table 2. Injured Body Parts (Match, Training, and Total)

Body Part Injured	Injuries, No (%)		
	Match (n = 170)[a]	Training (n = 114)[a]	Total (n = 286)
Head/neck	6 (3.5)	5 (4.4)	11 (3.8)
Head/face	6 (3.5)	4 (3.5)	10 (3.5)
Neck/cervical spine	0	1 (0.9)	1 (0.3)
Upper limb	3 (1.8)	4 (3.5)	7 (2.3)
Shoulder/clavicle	2 (1.2)	2 (1.8)	4 (1.4)
Elbow	1 (0.6)	0	1 (0.3)
Hand/finger/thumb	0	2 (1.8)	2 (0.6)
Trunk	18 (10.6)	12 (10.5)	30 (10.4)
Sternum/ribs/upper back	4 (2.4)	3 (2.6)	7 (2.4)
Lower back	7 (4.1)	7 (6.1)	14 (4.9)
Pelvis/hip	7 (4.1)	2 (1.8)	9 (3.1)
Lower limb	143 (84.1)	92 (80.7)	237 (82.9)
Groin	15 (8.8)	15 (13.2)	30 (10.5)
Thigh (posterior)	29 (17.1)	15 (13.2)	44 (15.4)
Thigh (anterior)	11 (6.5)	10 (8.8)	22 (7.7)
Knee	38 (22.4)	23 (20.2)	61 (21.3)
Lower leg/Achilles tendon	19 (11.2)	15 (13.2)	34 (11.9)
Ankle	20 (11.8)	10 (8.8)	30 (10.5)
Foot/toe	11 (6.5)	4 (3.5)	16 (5.6)
Unknown[b]	0	1 (0.9)	1 (0.3)

[a] Time of occurrence was missing for 2 injuries.
[b] Unknown because body part was not recorded.

percent of the injuries (n = 44) lasted more than 1 month. Injury severities are described in Table 4. No players had to end their soccer career because of an injury. After they were able to fully return to soccer training sessions or match play, 12.2% of the players (n = 35) still had complaints (mostly pain [n = 21] and swelling [n = 8]).

DISCUSSION

It is plausible that the incidence and severity of soccer injuries differ among European soccer leagues.[23] The aim of the present study was to investigate the incidence and characteristics of injuries in male soccer players in the Dutch premier soccer league.

We found an overall incidence of 6.2 injuries per 1000 player hours (95% CI = 5.5, 7.0), which is significantly lower than the overall incidence of 7.6 (95% CI = 7.0, 8.8) in Swedish competition[17] and the 14.2 incidence (95% CI =

Table 3. Type of Match, Training, and Total Injuries

Injury Type	Injuries, No. (%)		
	Match (n = 170)	Training (n = 114)	Total (n = 286)
Fractures and bone stress	4 (2.4)	5 (4.4)	9 (3.1)
Joint and ligament	40 (23.5)	13 (11.4)	53 (18.5)
Muscle and tendon	56 (32.9)	48 (42.1)	104 (36.4)
Contusions, skin lesions, and lacerations	42 (24.7)	9 (7.9)	51 (17.8)
Nervous system	3 (1.8)	2 (1.8)	5 (1.7)
Muscle and tendon + contusions, skin lesions, and lacerations	2 (1.2)	1 (0.9)	3 (1.0)
Other combinations	11 (6.5)	8 (7.0)	20 (7.0)
Other injuries	2 (1.2)	17 (14.9)	19 (6.6)
Overuse	10 (5.9)	11 (9.6)	22 (7.7)

Table 4. Severity of Match, Training, and Total Injuries

Injury Severity (Days Lost)	Injuries, No. (%)		
	Match (n = 170)[a]	Training (n = 114)[a]	Total (n = 286)
Minimal (1–3)	28 (16.5)	21 (18.4)	50 (17.5)
Mild (4–7)	53 (31.2)	38 (33.3)	91 (31.8)
Moderate (8–28)	56 (32.9)	41 (36.0)	98 (34.3)
Severe (>28)	30 (17.6)	14 (12.3)	44 (15.4)
Career ending	0	0	0
Unknown[b]	3 (1.8)	0	3 (1.0)

[a] Time of occurrence was missing for 2 injuries.
[b] Unknown because recovery date was not recorded.

9.1, 19.9) in Danish competition.[13] The training injury incidence of 2.8 (95% CI = 2.3, 3.3) in our study was also significantly lower than in the Swedish (5.3; 95% CI = 4.7, 5.8) and Danish (11.8; 95% CI = 6.7, 16.9) competitions. These differences cannot be explained by the use of different methods, as all 3 studies followed the international consensus agreements on procedures for data collection in epidemiologic studies of football injuries recommended by FIFA and UEFA.[21,22] In agreement with our finding of differences among these countries in the incidence of soccer injuries, a recent group[23] noted that teams from the northern parts of Europe had significantly higher incidences of overall injury (rate ratio = 1.12), training injury (rate ratio = 1.16), and severe injury (rate ratio = 1.29) than teams from the southern parts of Europe. Our hypothesis of regional differences in injury incidence within European professional soccer is confirmed.

In agreement with the results of several studies,[11,17,23] most of the injuries in our investigation affected the lower extremities (82.9%). Furthermore, 8% of the injuries were recurrent. These values agree with the findings of a UEFA injury study[12] and disagree with studies of Scandinavian professional soccer, in which recurrent injury rates varied between 22% and 30%.[13,16–18] According to Ekstrand et al,[12] one explanation for the difference might be that top-level clubs in Europe have more medical support and can provide more personalized rehabilitation for injured players. Furthermore, Bjørneboe et al[6] reported a difference in the league system in Norway and Sweden as compared with that of most European countries. Owing to climatic conditions, the Norwegian and Swedish league seasons run from April to October/November, with a 3-month preseason period starting in January. In most other European leagues, the soccer season starts in July and ends in May.

Strengths

The strength of the current study is that we collected and analyzed data on multiple soccer clubs within 1 national competition. Although we included only 8 of the 18 premier league teams, we argue that this is a representative sample of professional soccer players in the Netherlands. This argument is based on the mean ranking of the included teams at the end of the season (mean ranking = 7.8).

As stated by Árnason et al,[24] the precision of the reported incidence rates depends on the accuracy of the injury and exposure documentation and on correct diagnoses. Therefore, we followed established epidemiologic guidelines for injury comparisons.[21,22] Furthermore, the injury documentation was performed by medical experts (ie, physical therapist or team physician). In the Dutch premier league, physical therapists or team physicians (or both) usually attend all training sessions and are present during matches. The availability of the medical staff has improved the precision of the incidence rates and the correctness of the diagnoses.

Limitations

Reliability of injury recording is always a concern in epidemiologic studies.[12] We followed consensus statements on injury definitions and data-collection procedures for injury studies in football; these emphasize that injury epidemiology studies should be carried out prospectively and data should be collected by a member of the medical staff.[21,22] More injuries are recorded by prospective injury-documentation systems than with retrospective interviews.[25,26] However, Bjørneboe et al[6] concluded that a prospective injury-documentation system is not always complete. They studied the accuracy of a prospective injury-documentation system, based on medical staff reporting, by comparing its data with retrospective player interviews. Of the 123 acute injuries, 19% were only recorded through the player interviews, 54% by both methods, and 28% through the medical staff documentation, indicating that medical staff reports underestimated the incidence of time-loss injuries by at least one-fifth compared with player interviews. The teams in our study were competing on a professional level and had full access

Table 5. Cross-Tabulation of Locations and Types of All Soccer Injuries

Injury Type	Injury Location, No. (%)					
	Head/Neck	Upper Limbs	Trunk	Lower Limbs	Unknown[a]	Total
Fractures and bone stress	2 (0.7)	3 (1.0)	0	4 (1.4)	0	9 (3.1)
Joints and ligaments	0	2 (0.7)	1 (0.3)	50 (17.5)	0	53 (18.5)
Muscle and tendon	0	0	9 (3.1)	94 (32.9)	1 (0.3)	104 (36.4)
Contusions, skin lesions, and lacerations	1 (0.3)	0	6 (2.1)	44 (15.4)	0	51 (17.8)
Nervous system	5 (1.7)	0	0	0	0	5 (1.7)
Muscle and tendon + contusions, skin lesions, and lacerations	0	0	0	3 (1.0)	0	3 (1.0)
Other combinations	0	2 (0.7)	2 (0.7)	16 (5.6)	0	20 (7.0)
Other injuries	3 (1.0)	0	6 (2.1)	10 (3.5)	0	19 (6.6)
Overuse	0	0	6 (2.1)	16 (5.6)	0	22 (7.7)
Total	11 (3.8)	7 (2.4)	30 (10.5)	237 (82.9)	1 (0.3)	286 (100)

[a] Unknown because injury location was not recorded.

to medical staff, which might have reduced the risk of missing injuries during the documentation period. Therefore, we do not think we greatly underestimated the injury risk in the Dutch premier soccer league.

This study had some further limitations that need to be addressed. First, we collected data on only 1 soccer season. An advantage of a 1-season prospective study design is the small number of dropouts due to in-season transfers, but a disadvantage is that the findings may represent a chance occurrence for that particular season.[27] However, several prospective studies[14,15,17] of a number of seasons demonstrated no significant changes in injury incidence over time. These results indicated that a study covering 1 full season can provide a sufficient assessment of the injury incidence among soccer players. Second, Waldén et al[10] showed that half of the players belonging to teams participating in the Champions League had national team obligations. A total of 4% of all injuries occurred during matches played on the national team.[10] Our study did not take into account match exposure time and injuries sustained by players with national team obligations, which may have led to a slight underestimation of the injury risk in the Dutch premier league soccer players.

Practical Implications

There are several practical implications regarding this study. First, 35% of the players sustained multiple injuries, some up to 5 or more injuries. Players who sustained an injury before are at greater risk of an injury in the following season than uninjured players.[17] Athletic trainers should pay attention to follow-up during and after injury rehabilitation. As stated by Árnason et al,[24] returning to training too early and at high intensity after injury can partially explain the high risk of recurrent injuries observed. Our results indicate that a more intensive program of medical care may be a sound investment for the clubs.

Second, the factors most frequently mentioned as being related to an injury were contact with another player, jumping, and fatigue. One of the major concerns regarding contact with other players is tackling. Tackling is the most common cause of ligament sprains and will always carry an inherent risk of injury in soccer.[28] This might be responsible for the large number of injuries during matches compared with training. Reducing the number of contact injuries might be achieved by changing the rules of the sport.[29] Athletic trainers should focus on these factors. The effects of these contributing factors might be reduced by conditional and strength straining consisting of appropriate exercises to improve knee, ankle, and core stability. For example, FIFA has launched an injury-prevention program called The FIFA 11+, which is a complete warm-up program aimed at reducing injuries among male and female football players aged 14 years and older.[30]

Third, more than 3 of 10 injuries were overuse injuries. As suggested by Ekstrand et al,[12] the intensity at the professional level may contribute to this higher number of overuse injuries. Athletic trainers should take into account the effect associated with the number of players per team. A smaller team has fewer options to substitute for injured players, as well as for players who are more injury prone.

CONCLUSIONS

Injury risk in the Dutch premier soccer league is high, especially during matches. Preventive measures should focus on the most common diagnoses, namely, muscle/tendon injuries of the lower extremities.

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