



Injuries in male versus female soccer players : Epidemiology of a nationwide study

S. MUFTY, P. BOLLARS, L. VANLOMMEL, K. VAN CROMBRUGGE, K. CORTEN, J. BELLEMANS

From the department of orthopedic surgery, University hospitals Leuven, Belgium

The aim of this study is to analyse soccer injuries on a national scale over one decade and to compare injury rates by gender.

Detailed injury data obtained from the Royal Belgian Football Association from seasons 1999-2000 and 2009-2010 were recorded and gender differences in incidences of injuries, type of injury, affected body part and timing of injury were compared.

A significant decrease in injuries from 7.56 to 5.96 injuries per 100 players was seen ($p < 0.0001$). Overall male players sustained more contusions, fractures, joint dislocations and musculotendinous injuries than female players. Proportionally, females sustained more severe injuries than men ($p < 0.0001$). Significantly more injuries were sustained during competition in both males and females.

The number of injuries in male and female soccer players has decreased over the past decade. A higher injury rate was seen in men but proportionally, females sustained more severe injuries.

Keywords : Soccer injuries ; female ; epidemiology ; gender.

INTRODUCTION

Soccer is one of the most popular sports in the world. According to the FIFA (Fédération Internationale de Football Association) big count study, the overall total of registered and unregistered occasional soccer players worldwide was 265 million in

2006, an increase of almost 10% in six years. Twenty-six million, or nearly 10% of these players are female (8). The growth in women's soccer is particularly striking. The number of registered female players (at youth and senior level) has increased by 54% between 2000 and 2006. In Belgium, 42,200 male and 21,000 female players were registered in 2006, which placed Belgium in the top twenty for male and female registered players in the FIFA big count study (8).

Playing soccer has many health benefits : increased productivity, enhanced academic performance, stimulation of musculoskeletal, metabolic and cardiovascular adaptation and reduced risk of developing life style diseases (21). But soccer is a contact sport with an injury rate of one injury per player per season. Injuries possibly limit permanently further sports participation (12,14,25).

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- S. Mufty, MD.
 - P. Bollars, MD.
 - L. Vanlommel, MD.
 - K. Van Crombrugge, MD.
 - K. Corten, MD.
 - J. Bellemans, MD, PhD

Department of Orthopaedic surgery, University hospitals Leuven, Pellenberg, Belgium.

Correspondence : Mufty S., Department of Orthopaedic surgery, University Hospitals Leuven, Weligerveld 1, 3012 Pellenberg, Belgium. E-mail : Shevan.mufty@gmail.com

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The popularity of soccer is growing substantially. More particularly, the number of female soccer players has increased by 40% over the last decade. Injury incidence however, has significantly decreased in the last ten years for male as well as female soccer players. The popularity of soccer and the inevitability of soccer injuries when playing the game have substantial financial implications, particularly on the professional level. The total economic revenue of the leading European professional soccer clubs exceeds 4 billion US dollars (1). Accurate knowledge of morbidity and outcome of soccer related injuries is vital in adequately predicting players availability and rehabilitation.

The aetiology of soccer injuries is multi-factorial and “intrinsic” factors such as general condition, muscle tightness should be distinct from “extrinsic” factors such as weather conditions and playing surfaces (3,4). Preventative programs target these different parameters and multi-modal programs have been shown to effectively reduce the injury risk (16). Based on these findings, the FIFA’s Medical and Research Centre (F-MARC) has initiated in 2003 “The 11 injury prevention program” followed in 2006 by the advanced “11+ injury prevention program” (28).

The last decade numerous studies have been published focusing on injuries sustained while playing soccer (16). The number of studies on female soccer players is rather low and comparative studies between male and female soccer injuries are even scarcer (2,6,7,9,10,12,15,20,22,26,27,32,33).

An important topic of concern in young female soccer players is the complete anterior cruciate ligament (ACL) rupture. The greater part (70%) of all ACL injuries are noncontact injuries (13). The most common mechanism of a noncontact ACL rupture is a deceleration event and a sudden change in direction with a planted foot (i.e. cutting manoeuvre) (24).

Facing the frequency of injury, the resulting cost and personal suffering, prevention programs as the ‘11+ are slowly implemented in the world of soccer (28). An injury rate reduction of 50% to 70% can be obtained by implementation of prevention programs (5), particularly in prevention of non-contact injuries. A reduction of 11.5% of match injuries and

25.3% of training injuries in amateur soccer players has been reported and in young female soccer players the risk of injury is reduced by about one third ; severe injuries by as much as one half (17,28). A similar but somewhat smaller effect of the “11” program was noted in recreational soccer players in Swiss (17).

The aim of this study is to analyse soccer injuries on a national scale in all registered Belgian male and female soccer players and to compare injury rates by gender.

MATERIALS AND METHODS

For this retrospective cohort observational study, the Royal Belgian Football Association (RBFA) granted access to their database of all training or competition soccer injuries reported to their insurance system in the seasons 1999-2000 and 2009-2010.

The RBFA features a unique nation-wide insurance system that covers every member during official soccer activities. In order to get reimbursed by the RBFA insurance system soccer players report the injury to the RBFA insurance system by means of a standardized form completed by a qualified physician. The form consists of several parameters such as player and club identification, profession, date of the incident, circumstances and level of activity at time of injury (i.e. competition or training). Date of examination, diagnosis, relapse, intervention of a specialist, physiotherapist or radiologist, incapacitation and disability are filled in by a qualified physician. The detailed injury data from the first season (1999-2000) and second season (2009-2010) from every player in Belgium were retrospectively recorded and analysed. The data of both seasons with a decade interval were compared for incidence of injuries, type of injury, affected body part and the respective influence of gender on the abovementioned. Note that injury reports were analysed anonymously. If a soccer player renounces the RBFA insurance system and decides to report to a private or public health insurance or to not report at all, the injury is not included in the RBFA injury registry. There were no data available on the number of injuries that were reported to a private or public health insurance or injuries that were not reported at all.

Fractures, cartilage problems, tendon ruptures, concussions, ligamentous injuries and dislocations were classified as severe injuries. Youth players were defined as athletes of 18 years or younger and adults were defined as 19 years or older). Injuries are reported as

incidences per 100 players per season. Injury rates were compared between groups using a Poisson model and 95% confidence intervals (CI) were reported for the rate ratios (RR). Chi-square (χ^2) tests are used to compare the incidence between groups. In total 4,180 (13%) and 2,222 (9%) reports of respectively the first and second season were not complete (i.e. type of injury and characteristics of the player were not available). To account for these missing data, all calculations assumed that the missing information was completely at random. The observed incidences were therefore increased proportionally to the amount of injury reports without detailed injury information.

P-values < 0.05 are considered to be significant. Obviously, given the large sample size, statistical significant differences should also be evaluated on their clinical significance. Analyses have been performed using SAS software, version 9.2 of the SAS System for Windows.

RESULTS

A total of 833,396 soccer players were subscribed to the RBFA over the seasons 1999-2000 and 2009-2010. The first season (1999-2000) 417,462 active soccer players were affiliated to the RBFA of which 401,976 were male and 15,486 were female players. In the second season (2009-2010) 415,934 active soccer players including 394,250 male and 21,684 female players were affiliated to the RBFA (an increase of 40% of female players over a decade). The male to female ratio was almost 22/1 in both seasons. The total study group consisted of 509 or 61% youth players and 325 or 39% adults. The mean age was 22 years (range: 4-90, interquartile range: 11-28). In the first season, 28.100 injuries were registered. In the second season the number of injuries decreased to 23.146 reported injuries.

In the first season, 7.56 injuries per 100 players were registered. Ten years later, this number was significantly decreased to 5.96 injuries per 100 players (RR = 0.789, CI = 0.776-0.802, $p < 0.0001$). The injury rate was significantly lower in females than in males in both seasons (Table I). Overall, female soccer players had a significantly lower injury rate (5.23 per 100 players), which is 24% lower than their male counterparts (6.83 per 100 players) (RR = 0.766 CI : 0.730-0.804, $p < 0.0001$).

In total 12,083 injuries (21%) were classified as "severe" and this incidence significantly increased in the second season. In the first season 6,315 (20%) injuries were classified as severe compared to 5,768 (23%) in the second season ($p < 0.0001$) but there was a drop in severe injury rate from 1.7 to 1.5 (RR = 0.917, CI = 0.885-0.950, $p < 0.0001$). There were in total 6484 fractures (12%).

Male players sustained significantly more contusions, fractures, joint dislocations and musculotendinous injuries than female players (Table I). Male players sustained more fractures of the upper and lower limb, respectively (0.51 vs. 0.4 per 100 players ($p = 0.003$)) and (0.24 vs. 0.18 per 100 players ($p = 0.0259$)). Amongst the upper limb fractures, radial fractures (0.18 vs. 0.14 per 100 players ($p = 0.0347$)) and fractures of the hand (0.056 vs 0.030 per 100 players ($p = 0.0183$)) occurred significantly more in men than in women. In lower limb fractures, more fractures of the foot were seen in men than in women (0.09 vs. 0.05 per 100 players ($p = 0.0097$)). Male players also had more injuries of the shoulder, hand, foot and knee. The injury rate was 0.21 vs. 0.16 per 100 players ($p = 0.0403$) for shoulder injuries, 0.47 vs 0.35 per 100 players ($p = 0.0004$) for hand injuries, 1.36 vs. 1.17 per 100 players ($p = 0.0015$) for knee injuries and 0.35 vs. 0.20 per 100 players ($p < 0.0001$) for foot injuries.

Table I. — Injuries reported

Type of Injury	Number of cases	Number of players	Number of cases per 100 players	Chi-square value	p-value
Contusion M/F	11,406/427	796,226/37,170	1.6162/1.2961	24,5	< 0.0001
Fracture M/F	6,258/225	796,226/37,170	0.8868/0.6830	18,2	< 0.0001
Dislocation M/F	989/30	796,226/37,170	0.1401/0.0911	6,9	0.0086
Musculotendinous Injury M/F	9,244/225	796,226/37,170	1.3100/0.6830	131.6	< 0.0001

Significantly more anterior dislocations were seen in male than in female soccer players (0.04 vs. 0.02 per 100 players ($p = 0.0278$)). Significant differences were noted in the incidence of fractures of the hand (cf. supra) and dislocations of the fingers (0.025 vs. 0.009 per 100 players ($p = 0.0179$)). In knee injuries, distortion (0.50 vs. 0.41 per 100 players ($p = 0.0146$)), lateral collateral ligament injuries (0.03 vs. 0.01 per 100 players ($p = 0.0252$)) and lateral meniscal injuries (0.05 vs. 0.03 per 100 players ($p = 0.0418$)) were seen significantly more in men than in women. On the other hand, females were more likely to develop iliotibial friction syndrome than males (0.01 vs. 0.003 per 100 players ($p = 0.0207$)).

Males are more likely to sustain an injury of the lateral collateral ligament (0.21 vs. 0.16 per 100 players ($p = 0.0497$)). Females however, are more at risk for injuries of the Lisfranc joint (0.0007 in males vs. 0.006 in females per 100 players ($p = 0.0458$)) and development of tendinopathy of the long peroneal muscle (0.02 vs. 0.06 per 100 players ($p = 0.0312$)).

Adult females were at higher risk for severe injuries (Table II and III). The proportion of severe injuries was significantly higher in women in comparison with men, 11,644 of 48,226 injuries (24.14%) in male players versus 436 out of 1,724 injuries (25.29%) in female soccer players ($p < 0.0001$). Dislocation of the hip joint was seen in two female players whereas none occurred in male soccer players. An insignificant increase of

Table II. — Gender specific percentages of soccer related injuries. The total of the percentages sums up to more than exactly 100% since one player equals one file and it is possible that one player sustained multiple injuries

Injury	Male / Female
Sprain	33.92% / 41.53%
Contusion	23.65% / 24.77%
Fracture	12.98% / 13.05%
Dislocation	2.05% / 1.74%
Musculotendinous	19.17% / 13.05%
Other	9.15% / 7.25%
Severe	24.14% / 25.29%

Table III. — Gender specific percentages of soccer related injuries for adult male and female soccer players. The total of the percentages sums up to more than exactly 100% since one player equals one file and it is possible that one player sustained multiple injuries.

Injury	Male / Female
Sprain	37.43% / 43.40%
Contusion	20.57% / 23.61%
Fracture	9.85% / 12.06%
Dislocation	2.30% / 1.86%
Musculotendinous	21.48% / 13.51%
Other	9.29% / 6.91%
Severe	23.13% / 26.08%

Table IV. — Gender specific percentages of soccer related injuries for youth soccer players only. The total of the percentages sums up to more than exactly 100% since one player equals one file and it is possible that one player sustained multiple injuries

Injury	Boys / girls
Sprain	28.73% / 39.86%
Contusion	28.24% / 25.85%
Fracture	17.58% / 14.15%
Dislocation	1.68% / 1.63%
Musculotendinous	15.79% / 12.65%
Other	8.90% / 7.35%
Severe	25.58% / 24.08%

ACL ruptures (0.10 vs 0.08 per 100 players) and concussions (0.11 vs 0.08 per 100 players) was seen in the female population. Interestingly, male players younger than 18 years sustained more severe injuries than young female players (Table IV).

The 3 most common injuries were similar for males and females. Ankle injuries prevailed : 10,961 in males and 509 in females respectively. The single most common injury was sprain of the ankle ($n = 7,017/79,6226$ in males, $n = 351/37,170$ in females), followed by distortion of the knee ($n = 3,530/796,226$ in males, $n = 136/37,170$ in females) and contusion of the knee ($n = 2,823/796,226$ in males, $n = 119/37,170$ in females). In both women and men, sprain is the most common type of injury with respectively 2.17 and 2.31 cases per 100 players. Significantly more injuries are sus-

Table V. — Gender specific distribution of injuries sustained during practice and matches

Situation	Number of cases	Number of players	Number of cases per 100 players	Chi-square value	p-value
Training M/F	17,046/572	796,226/37,170	2.42/1.75	62.2	< 0.001
Match M/F	31,164/1,152	796,226/37,170	4.42/3.53	63.2	< 0.001

tained during competition than during practice. However, males sustained significantly more injuries than females during practice as well as during competition (Table V).

DISCUSSION

A nationwide database allowed us to investigate over a decade of preventive measures the gender specific epidemiology, the change in incidence, severity and location of soccer related injuries.

The most important finding of this study was that female soccer players sustained 24% less injuries than their male colleagues. However, the incidence of severe injuries was significantly higher in the female population. These results are comparable to those found in the study from Hägglund *et al* and Giza *et al* amongst respectively Swedish male and female soccer players and players of the Women's United Soccer Association (WUSA) and male Major League Soccer (MLS). They both conclude that injury incidence was higher in the male soccer population (10,12). Two studies found no differences in injury incidence when comparing male versus female soccer players (18,33). One study found a higher injury incidence in female than in male soccer players (6). These higher incidences in male soccer players are mainly due to higher velocity and intensity of play (14). In this study the incidence of severe injuries was higher in males than in females. However, in agreement with Hägglund *et al*, we found a higher overall incidence of severe injuries in female players as compared to male players (12). The explanation for this finding can be multifactorial. First, the number of female skilled players is mostly rather low and skilled players might be the victim of "over-matching". Skilled players are more involved in the game and therefore more prone to tackles and foul play (27). Second, medical support in female soccer is lower: delayed diagnosis and

less optimal rehabilitation of injured players could lead to recurrence of injuries or more severe injuries. Third, female soccer nowadays has a very tight schedule, approaching that of male soccer, the level of professionalism in adult female soccer is still lower and most adult players still have a regular job besides soccer, have less time to prepare for training or matches, less time for recovery and proper nutrition.

An important topic of concern in young female soccer players is complete ACL rupture. ACL ruptures in females were 1.3 times more frequent than in males (0.10 vs. 0.08 per 100 players), however, these differences in our study were not found to be significant. Others indicated that ACL injury is approximately three times higher in females than in males in soccer and basketball (23,32). A female-to-male injury ratio of 2.67 was seen in soccer, 3.5 in basketball, 4.05 in wrestling, and 1.00 in alpine skiing (23). The idea that the higher rate of complete ACL ruptures among females is the result of lack of experience in soccer has been disproved since increased participation of girls and women in organized participation did not lead to a reduction in ACL injury rates. Possible contributors to higher female injury rates are a greater Q-angle, smaller ACL size, narrower intercondylar notch, and increased medial posterior tibial slope (29). Neuromuscular and proprioceptive preseason protocols designed to train female athletes to avoid placing their knees in at-risk positions on landing or in cutting manoeuvres have been successful in reducing the incidence of injury in various sports (29). Preseason protocols are likely to be most effective, and continuation throughout the season and perhaps the athlete's entire career may be most effective. Studies have shown that deconditioning can occur within 2 to 8 weeks (11). Similar to previous research we found higher injury rates in competition than in practice (2,20,33).

The total amount of injuries significantly reduced by 21% over the course of one decade.

Preventive programs are increasingly implemented in Belgian soccer, but exact data regarding implementation are missing. We believe that preventive programs should focus more on female athletes given the additional risk factors and greater frequency of injuries in soccer.

The shortcomings of this study are that registration of soccer injuries through insurance files is predominantly done in more serious and acute injuries, reflecting in a high percentage of severe injuries. We consider our registration system as accurate in collecting severe soccer injuries. Overuse injuries and less serious injuries such as contusions and abrasions are not likely to be reported (31). It is estimated that only 43% were medically reported of all injuries (30). The current RBFA injury report is often filled out at the initial incidence by a physician without an adequate diagnosis. We believe that the large number of data sustains the validity of our conclusions. On the basis of these limitations, recommendations were made to the RBFA in order to construct a new, electronic injury report form. Due to administrative reasons, from a portion of the injury reports no details were available with respect to type of injury (n = 4,180 or 13.2% in the first season, n = 2,222 or 9.0% in the second season). In all calculations it has been assumed that the missing information is completely at random, i.e. injury reports with details are representative for injury reports without details. Observed incidences are therefore increased proportionally to the amount of injury reports without detailed injury information. Note that injury reports were analysed anonymously. Therefore, using the number of players as denominator to report the incidence per 100 players is a subtle simplification in the sense that it ignores that more than one injury report can theoretically originate from the same player.

Comparison between different epidemiological studies is difficult given the different study designs and epidemiologic factors such as injury definition, categorization of injury, injury severity etc., which may influence the study results (19).

Despite the increase in sportive and financial pressure, contemporary soccer inflicts fewer inju-

ries in Belgian soccer compared to one decade ago. Possible explanations for this positive trend are a good prevention program (the FIFA 11+ program), better medical care and renewed postponement policy by the RBFA. A higher injury rate was seen in male soccer players, nonetheless overall, proportional, females sustained more severe injuries than male soccer players. Interestingly we observed no significant differences in the rate of knee ligament injury, including ACL injury, which is in contrast to previous findings. Given the many gender-specific differences in injury incidences and risk factors for soccer related injuries, further development and implementation of gender specific adaptations to the currently existing injury preventive programs are needed.

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