Acta Orthop. Belg., 2013, **79**, 541-546

ORIGINAL STUDY

The incidence of knee and anterior cruciate ligament injuries over one decade in the Belgian soccer league

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In an epidemiological study we assessed the evolution in the incidence and possible risk factors of knee injuries, especially anterior cruciate ligament (ACL) injuries, in Belgian soccer over one decade.
Two soccer seasons (1999-2000 and 2009-2010) were compared and 56.364 injury reports registered by the KBVB-URBSFA were retrieved. Knee injuries totaled 9.971 cases, 5.495 in the first season (1999-2000) and 4.476 in the second (2009-2010) : a significant decrease in incidence from 1.5 per 100 players in 2000 to 1.2 knee injuries in 2010. Six percent of all knee injuries were ACL injuries. The reported incidence of ACL tears slightly increased from 0.081 to 0.084 per 100 players. Female gender, competition and age over 18 years were prognosticators for ACL injuries.
Enhanced prevention programs for ACL injuries, especially in those sports groups are warranted.

Keywords : soccer ; knee ; injury ; anterior cruciate ligament ; gender variance.

INTRODUCTION

Injuries to the lower extremity occur most frequently in contact sports such as soccer or American football (*9,15,16,23,25*). Soccer is one of the most popular sports in the world, with 265 million participants (*8,19,22*). Most injuries are either caused by direct impact or by twisting or pivoting maneuvers (*3,11,12,14*). Of all injuries, anterior cruciate ligament (ACL) injuries account for 1.3% in male and 3.7% in female soccer players (*8,22*). The risk factors most prominent for ACL injuries remain a subject of debate. The ACL is prone to torsional injuries : approximately 70% of ACL ruptures occur with the knee in or near full extension such as during landing maneuvres or pivoting on a plantigrade foot (*3,10*). Cutting maneuvres combined with deceleration have also been associated with an increased risk of ACL injuries (*3,11*).

In Belgium over 400.000 players participate annually in soccer and are members of the Royal Belgium Football Association (KBVB-URBSFA). The association collects all injuries rigorously in a national registry since the early nineties. This registry represents an impressive database of injuries and allows for comparison of changes in injury patterns over a decade of registration. This study aimed to

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No benefits or funds were received in support of this study.
The authors report no conflict of interests.

investigate the incidence of knee injuries over a decade in the Belgian soccer league and to identify prognosticators for ACL injuries.

MATERIAL AND METHODS

The KBVB-URBSFA features a unique nation-wide insurance system that covers every member during official soccer activities. As a result, all acute injuries that occurred during training activities or during competition are reported and collected in the injury registry. The injuries are always documented by a qualified physician in the outpatient clinic or in the emergency room on a standardized leaflet. The leaflet consists of several parameters such as name, date of birth and subscription number of the player, name and division of the club, profession, date of the incident, circumstances and level of activity at time of injury (i.e. match or training). Date of examination, diagnosis, relapse, intervention of a specialist, physiotherapist or radiologist, incapacitation and disability are filled in by a qualified physician. A completed leaflet is required for the patient in order to get reimbursed by the KBVB-URBSFA insurance system.

A total of 56.364 documented reports were retrieved for the compiled seasons 1999-2000 and 2009-2010. The data of both seasons were compared for type of injury, affected body part, severity, timing (i.e. training or competition), gender, age and level of performance (i.e. recreational or national level athlete). We classified fractures, cartilage injuries, tendon ruptures, concussions, ligamentous injuries and dislocations as "severe" injuries. Age was categorized as junior versus adult. Junior players (N = 508.874) (61%) were defined as athletes of 18 years or younger and adults were defined as 19 years or older (N = 324.522) (39%). The level of performance was categorized as national versus recreational level. In total 124.046 players (15%) were national level players of the 4 highest divisions of the Belgian soccer league. In total 709.350 recreational players (85%) played in the regional soccer leagues.

Injuries were reported as incidences per 100 players per season. X^2 tests were used to compare the incidence between groups. P-values < 0.05 were considered significant. Analyses have been performed using SAS software, version 9.2 of the SAS System for Windows (SAS Institute Inc., Cary, NC, USA).

KBVB-URBSFA enlisted a total of 833.396 soccer players during the seasons of 1999-2000 and 2009-2010, including 394.250 (95%) male and 21.684 (5%) female members in the first season and 401.976 (96%) male and 15.486 (4%) female members in the second season. Male to female ratio was comparable in both seasons (22/1). The mean age was 22 years (range 4-90).

A total of 56.364 injuries were recorded : 31.563 (56%) in 2000 and 24.801 (44%) in 2010. The mean incidence was 7.6 injuries per 100 players in 2000 and 6.0 in 2010 ($p < 0.0001$). Knee injuries totaled 9.971 cases (18%) of which 5,495 in the first and 4,476 in the second season : incidence decreased significantly from 1.5 to 1.2 per 100 players over 10 years' time ($p < 0.0001$). The most frequently reported diagnoses were "contusion" (N = 2,943) and "distortion"(N = 3,668). These undetailed diagnoses were therefore discarded. This left 3,360 well reported and diagnosed knee injuries.

RESULTS

A significant reduction in almost every type of knee injury, with the exception of ACL injuries, was seen between both seasons ($p < 0.0001$) (Table I). The incidence of medial meniscus injuries diminished by 36% and of lateral meniscus injuries by 41%. Similarly, there was a reduction of 21% and 37% respectively in the incidence of medial and lateral collateral ligament injuries (Table I and Fig. 1). ACL tears during the 10-year time interval increased slightly but not significantly by 7 % (293 versus 318, i.e. 0.081 versus 0.084 per 100 players $p = 0.64$). The incidence of other typical knee injuries such as patella tendon rupture, patella dislocation and PCL rupture was not significantly different in the two soccer seasons (Table II).

Knee injuries were more likely to occur during competitive activities than during training sessions ($p < 0.0001$). More specifically, 427 ACL tears (70%) occurred during competitive activities in comparison to 184 (30%) during training. Although the female to male ratio for ACL tears was 1.29, female gender was not a significant prognosticator for ACL tears in our study. There were 579 ACL tears in males and 32 in females with a mean incidence of 0.097 per 100 female players per season in comparison to 0.082 per 100 male players per season ($p = 0.34$). In junior players the incidence of ACL tears slightly increased over both seasons with a reported incidence of 0.027 and 0.035 injuries per 100 players per year, respectively ($p = 0.1$). Comparing juniors and adults the respective incidence was 0.0003 and 0.0015. The incidence of ACL

Table I. — Detailed analysis of the most frequent injuries of the knee joint through season 1999-2000 and 2009-2010

Indication	Year	Number of cases	Number of players	X^2	P
Distortion	2000	2031	417 462	69.8	< 0.0001
	2010	1637	415 934		
Contusion	2000	1592	417 462	36.1	< 0.0001
	2010	1351	415 934		
Tibia fracture	2000	218	417 462	29.0	< 0.0001
	2010	131	415 934		
Fibula fracture	2000	112	417 462	72.2	< 0.0001
	2010	25	415 934		
Medial meniscus injury	2000	540	417 462	59.3	< 0.0001
	2010	344	415 934		
Lateral meniscus injury	2000	221	417 462	30.9	< 0.0001
	2010	131	415 934		
Medial collateral ligament injury	2000	522	417 462	21.2	< 0.0001
	2010	411	415 934		
Lateral collateral ligament injury	2000	142	417 462	16.6	< 0.0001
	2010	89	415 934		
Anterior cruciate ligament injury	2000	293	417 462	0.2	< 0.6398
	2010	318	415 934		

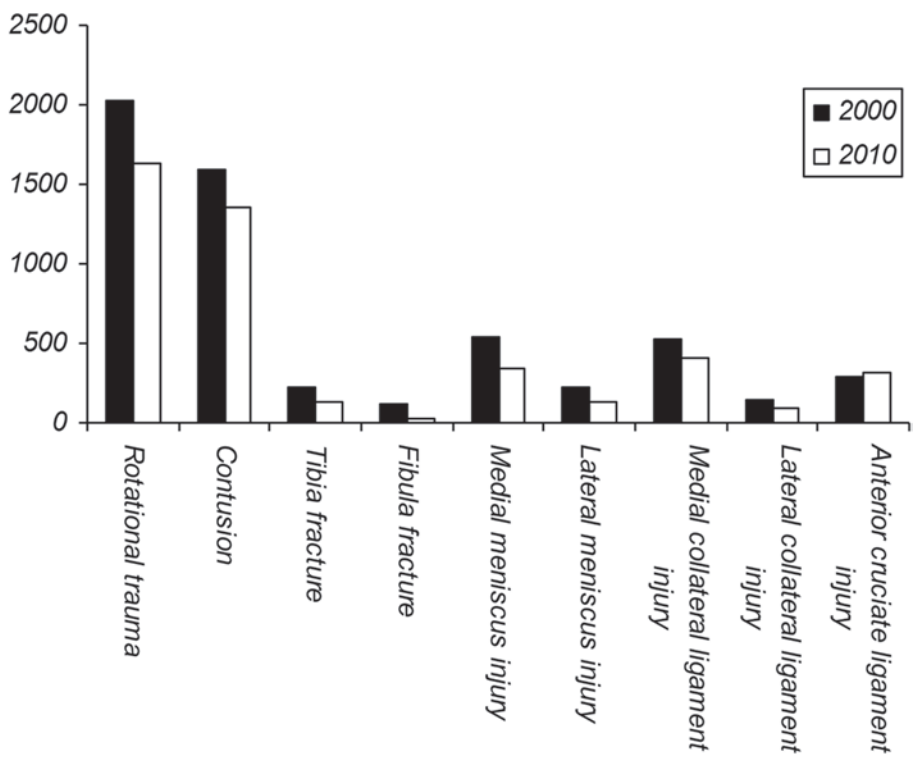

Fig. 1. — Analysis of the most frequent knee injuries through seasons 1999/2000 and 2009/2010

Table II. — Incidence of other typical knee injuries between soccer seasons 1999-2000 and 2009-2010

Type of injury	2000 (incidence per 100 players)	2010 (incidence per 100 players)	p-value
Patella tendon rupture	15	21	0.34
Patella dislocation	82	101	0.25
PCL injury	21	10	0.027

injuries in higher and lower classified soccer teams was comparable, at respectively, 0.076 per 100 players of national level and 0.084 per 100 players of recreational level (p = 0.35).

DISCUSSION

The KBVB-URBSFA database of injuries provided a clear view on the changes in reported injuries over a decade and helped to define prognosticators for knee injuries. The registry covers soccer injuries sustained by thousands of participants. Although the injury registry can be considered as representative for soccer injuries at large, some limitations should be noted. First, 4.180 (13%) injury reports in 2000 and 2.222 (9%) in 2010 did not provide sufficient details with respect to the type of injury. Therefore, these injuries had to be discarded. In addition, the missing information was considered as completely at random, i.e. injury reports with detailed information were considered as representative for injury reports without detailed information. Observed incidences can therefore be considered as increased proportionally to the amount of injury reports without detailed injury information. Second, injury reports were analyzed anonymously. Therefore, using the number of players as a denominator to report the incidence per 100 players is a subtle simplification : it ignores the possibility that more than one report originates from the same player. However, we believe that the provided information and conclusions can be considered as valid due to the extent of the reports, which represented over 56.000 injuries. Third, no distinction between non-contact and contact ACL injuries was made.

Fourth, the increased diagnostic ability of reporters between the two periods was not accounted for and may have influenced the figures, most certainly in the increased diagnosis of ACL injuries.

Knee injuries accounted for 18 % of all injuries over both seasons, which is a comparable finding to other published data on soccer related injuries (*7,19,21*). Six percent of all knee injuries were ACL injuries. It is of interest that the incidence of ACL injuries did not follow the overall decreased incidence of knee injuries. Some prognosticators for ACL injuries were identified such as female gender, competition sport activities and adult age. Literature findings concluded that female gender was the most important risk factor for ACL injuries in sports involving jumping, cutting and pivoting maneuvers such as football, basketball and volleyball. Females have a reported risk factor for ACL injuries 2 to 6 times higher than their male counterparts (*1,7, 17,18,23,25*). Although this did not reach significance in our data, we observed a 1.3 times higher risk in females. Whether this higher susceptibility is caused by hormonal changes remains subject of debate (*3,20*). Our data, in conjunction with the data from the literature, clearly indicate that preventive programs should focus on female athletes. In accordance to other studies, we also found that competitive activities were more likely to induce ACL injuries than training activities (*2,15,24,25*). It would be of interest to know whether these injuries occurred at an early or later stage during the game ; we were not able to note this from our data. Finally, several explanations might be found for the higher incidence of ACL injuries in older players such as fatigue due to longer training and competition times, higher speed and a more aggressive play style (*6,21*). Of interest is that a higher level of performance was not associated with an increased risk for ACL injuries, despite the fact that the aforementioned parameters are even more pronounced in elite soccer players. Better training modalities and prevention measures may explain this finding (*5,10, 20,24*).

There is a growing body of evidence that preventive measures effectively decrease the level and incidence of sports injuries (*5,10,16,19,20,24*). Competitive team sports require lower extremity dynamic stability to withstand the demands of cutting, decelerating and jumping maneuvers. The Prevent injury and Enhance Performance (PEP) Program for ACL injury prevention consists of warm-up, stretching, strengthening, and sport-specific agility exercises to address potential deficits in the strength and neuromuscular coordination of the stabilizing muscles around the knee joint. The primary goal of this program is to address the feed-forward mechanism to anticipate external forces or loads to stabilize the knee joint. Gilchrist *et al* observed an 83% decrease of ACL injuries the first year after implementation of the PEP Program and a slightly lower reduction of 74% after the second year (*10,20*). In addition, lower extremity plyometrics, dynamic balance and strength, stretching, body awareness and decision-making, and targeted core and trunk control appear to be successful training components to reduce non-contact ACL injury risk factors (*4*). These specific programs are currently not well known in most Belgian soccer teams, but the slightly increased incidence in ACL-injuries over the past decade indicates that general awareness of the effectiveness of such programs should be supported and enhanced, especially in adult players and females.

In conclusion, a reduction in the incidence of most knee injuries was observed over one decade of Belgian soccer. Adult age, female gender and competitive activities were identified as risk factors for ACL injuries. More specific ACL-targeted protective programs seem to be warranted in order to decrease the incidence of ACL tears, especially in females and players older than 18 years of age.

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