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FOOTBALL INJURIES DURING EUROPEAN CHAMPIONSHIPS 2004-2005

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ABSTRACT

The risk of injury in football is high, but few studies have compared men's and women's football injuries. The purpose of this prospective study was to analyse the exposure and injury characteristics of European Championships in football and to compare data for men, women and male youth players.

The national teams of all 32 countries (672 players) that qualified to the men's European Championship 2004, the women's European Championship 2005 and the men's Under-19 European Championship 2005 were studied. Individual training and match exposure was documented during the tournaments as well as time loss injuries.

The overall injury incidence was fourteen times higher during match play than during training (34.6 vs. 2.4 injuries per 1000 hours, $p < 0.0001$). There were no differences in match and training injury incidences between the championships. Teams eliminated in the women's championship had a significantly higher match injury incidence compared to teams going to the semi-finals (65.4 vs. 5.0 injuries per 1000 hours, $p = 0.02$). Non contact mechanisms were ascribed for 41% of the match injuries. One-fifth of all injuries were severe with absence from play longer than 4 weeks.

In conclusion, injury incidences during the European Championships studied were very similar and it seems thus that the risk of injury in international football is at least not

higher in women than in men. The teams eliminated in the women's championship had a significantly higher match injury incidence than the teams going to the final stage. Finally, the high frequency of non contact injury is worrying from a prevention perspective and should be addressed in future studies.

KEY WORDS

Athletic injuries, epidemiology, football, incidence

INTRODUCTION

The overall injury level of professional footballers has been shown to be high, approximately 1000 times that of common industrial occupations generally regarded as high risk [4]. The Federation of International Football Associations (FIFA) and the Union of European Football Associations (UEFA) amongst others are concerned about the risk profile and injury characteristics of the sport. For example, a methodological consensus statement from representatives of the major football research groups in the world was recently published [9].

Although injury characteristics of international championship matches are well described [16, 17, 18], little is known about training injuries in this environment. Another dilemma in the football literature is that studies comparing men's and women's football injuries are few. The studies conducted in this field have, however, found a similar or a lower incidence of injury in women's professional or international football compared to men's [10, 17, 18, 20]. Even if the overall risk of injury is not different, there may be clinically important differences in the injury pattern between the sexes, for instance regarding knee injuries [1, 24].

This prospective survey studied three European Championships in football: the men's senior championship in Portugal 2004 (EURO 2004), the women's senior championship in England 2005 (WOCO 2005), and the men's under-19 championship in Northern Ireland 2005 (U-19 2005). The main purposes were to analyse the injury characteristics taking both match and training exposure into account and to compare the incidence of

injury in international football for men, women and male youths. Our hypothesis was that the risk of injury is not higher in the women's championship than in the men's championships.

MATERIAL AND METHODS

The national teams of all countries qualifying to the three UEFA European Championships were studied prospectively throughout the tournaments. During the EURO 2004, the sixteen qualifying countries were allotted to four groups of four teams each. All teams played three group matches and the top two teams from each group entered the quarter-finals. In the WOCO 2005 and U-19 2005, the eight qualifiers were allotted to two groups of four teams each. In these two tournaments, all teams played three group matches and the top two teams from each group entered the semi-finals. Prior to the opening matches, signed informed consent was obtained from all 672 players involved. Players injured at the start of the study were included, but current injury was not taken into account [9, 13]. No player denied participation or dropped out during the study period.

All football training and match play occurred on natural grass. Individual exposure to all training sessions in minutes was documented on a standard attendance record form [13]. Only team-based and individual physical activities under the control or guidance of the team's coaching or fitness staff aiming at maintaining or improving player's football skills or physical condition were regarded as training [9], but the specific type of training was not recorded. Individual match exposure was taken from the official match records and did not include pre-match warm up and post-match cool down. Since any time added is the result of interrupted play, the maximum match exposure was normally 90 minutes. Matches were divided into six periods of 15 minutes each. Time loss injury was defined as an incident occurring during scheduled training sessions or

matches causing the player to miss the next training session or match [13, 25]. Injuries were divided into traumatic (resulting from a specific, identifiable event) and overuse injuries (caused by repeated microtrauma without a single, identifiable event) [9]. The national team physician documented each injury immediately after the event on a standard injury card. The injury card provided information on the date of injury, activity (training or match), injury type, injury location, injured side, injury circumstance and injury mechanism. For match injuries, the occurrence of foul play was filled in on the injury card as well as the minute when the injury occurred if this was known. Cards were delivered to the study group every third day together with the attendance record for that period. A player was considered injured until the team physician allowed full participation in all types of training or match play [9, 13]. Players leaving the tournament injured were followed by their national team doctor until full return to play for their home club was allowed. All injuries were classified by type and location and also given a specific injury diagnosis by the study group according to a modified Orchard Sports Injury Classification System (OSICS) [23].

Injury severity was defined as the number of days from the date of injury to the date of return to full participation in team training and availability for match selection [9]. The injuries were classified into six categories of severity: slight (0 days), minimal (1-3 days), mild (4-7 days), moderate (8-28 days), severe (> 28 days), and career ending [9]. Only incidents resulting in absence from a second scheduled football activity on the same day were classified as slight injuries. Foul play was defined as violation of the laws of football according to the referee and was reported for traumatic match injuries. A recurrent injury was defined as an injury of the same type and at the same site as an

index injury occurring after a player's return to full participation from the index injury [9]. Only index injuries occurring during the championships were considered when classifying subsequent recurrences.

Approximately one month before each tournament, all national team **physicians** were informed about the survey by mail. Enclosed was a specific study manual containing information about study purpose, design and definitions as well as examples of how to fill in the different study forms [13]. All team physicians also took part in a pre-tournament instruction meeting held by one of the authors the day before the opening matches. All authors took part in the data collection and at least one of the authors was present during the championships to ensure reliable data. The team physicians were contacted regularly, at least every third day when the forms were delivered, to obtain a high response rate and to clarify any doubts.

Statistics

Exposure was documented individually in minutes and expressed as the number of playing hours. Training frequency and training exposure were normally distributed and differences between the tournaments were analysed by one-way factorial ANOVA (Analysis of Variance) and Fisher's post hoc test. Injury incidence is expressed as the mean number of injuries per 1000 hours of exposure with the corresponding standard deviations (SD). Injury incidences were not normally distributed and all incidence analyses were non-parametric (Mann-Whitney U test, Wilcoxon Signed Rank test and Kruskal-Wallis test). Sub analyses of comparisons between the tournaments were made for four of the most common injury subtypes (all consisting >5% of all injuries).

Categorical data for injury circumstances were analysed using the chi-square test or the Fisher's exact test. The significance level was set at $p < 0.05$.

RESULTS

Exposure

The attendance record delivery rate was 100% for all three tournaments. The number of training sessions during the group stage varied between the teams involved: 6-11 in EURO 2004 (two weeks), 5-8 in WOCO 2005 (one week) and 3-6 in U-19 2005 (one week). A significantly higher mean (SD) number of training sessions per group stage week was found in WOCO 2005 (6.3 (1.0) training sessions) than in both EURO 2004 (4.1 (0.6) training sessions, $p<0.0001$) and U-19 2005 (4.3 (1.0) training sessions, $p<0.0001$), but no difference was seen between EURO 2004 and U-19 2005 ($p=0.74$). No exposure differences were seen between the teams eliminated in the group stage and those going to the finals.

Incidence of injury

There were on average 1.0-1.2 injuries per match. The injury incidence for all three championships was 11.3 (10.8) injuries per 1000 exposure hours (34.6 (32.8) injuries per 1000 match hours vs. 2.4 (4.7) injuries per 1000 training hours, $p<0.0001$). The incidence of injury was similar in all three European Championships with no significant differences during training ($p=0.61$), match play ($p=0.98$) or overall ($p=0.75$), respectively (Table 1). Teams eliminated in the group stage in WOCO 2005 had a significantly higher match injury incidence compared to the teams that went to the semi-finals (13 match injuries vs. 1 match injury; 65.4 (34.3) injuries per 1000 match hours vs. 5.0 (10.1) injuries per 1000 match hours, $p=0.021$).

Injury categories

The injuries consisted of 76 index injuries and 4 recurrences. The most common injury subtypes were thigh strain and ankle sprain, each contributing 12.5% of all injuries (Table 2). There were no differences between the tournaments in the incidences of adductor strain of the groin ($p=0.77$), thigh strain ($p=0.33$), knee sprain ($p=0.85$) and ankle sprain ($p=0.86$). Injuries categorised as “other” all resulted from overuse and consisted of lumbar disc prolapse with sciatic pain, delayed onset muscle soreness of the biceps femoris muscle, knee joint synovitis, ankle joint synovitis, and anterior chronic exertional compartment syndrome of the lower leg. Another three absences resulted from overuse: one patellar tendinopathy (one index injury) and one stress fracture of the navicular bone (one index injury and one recurrence).

Injury circumstances

Injuries occurring without contact with another player or object were common (Table 1), but no difference in the proportion of non contact injury was seen between the tournaments ($p=0.49$). A significantly higher number of contact injuries occurred during match play compared to training (40/68 vs. 2/12), $p=0.007$). The exact minute of injury was known for 51 match injuries with no difference in injury distribution between the first and second halves (26 vs. 25 injuries, $p=0.69$). However, a significantly higher proportion of non contact injury compared to contact injury was seen in the second half (71% (10/14) vs. 41% (15/37), $p=0.049$).

Seventy per cent of all traumatic match injuries (40/57) resulted from contact and 30% (17/57) were caused by foul play. There were 16 injuries due to opponent foul and one

injury due to own foul. There were no differences in the frequency of foul play injuries between the two halves ($p=0.27$) or the six 15-minute periods ($p=0.31$).

Injury severity

Injury resulted in 224 days of absence during the tournaments with 176 missed training sessions and 50 missed matches. Another 828 days were spent in rehabilitation after the championships resulting in a mean (SD) absence from football of 13 (19) days per injury and 46 (20) days per severe injury. There were no differences in injury severity between the three tournaments. Apart from slight injuries, incidences for the different categories of injury severity were significantly higher during match play (Table 3). The traumatic match injuries caused by foul play were significantly less severe than the rest of the injuries ($p<0.026$). Only one of the 11 severe match injuries was due to foul play (own foul).

DISCUSSION

The two principal findings of the present study were that the incidence of injury was similar in all three European Championships and that the frequency of non-contact injury was high despite a low risk of overuse injury. Another interesting finding was that the teams eliminated in the women's championship had a significantly higher match injury incidence during the group stage than the teams going to the final stage.

Incidence of injury

The injury incidence was similar in all three European Championships without significant differences between the tournaments. This finding agrees well with the most recent study conducted by the FIFA Medical Assessment and Research Centre (F-MARC) during the Olympic Games in Athens 2004, where the incidences of injury in the men's and women's tournaments were found to be similar [18]. However, these results differ from previous F-MARC studies, where the match injury incidence was reported to be significantly lower among women at the Olympic Games in Sydney 2000 as well as when comparing the men's World Cup in France 1998 with the women's World Cup in USA 1999 [17].

The injury definition used in the F-MARC studies (any physical complaint incurred during a match regardless of the consequences with respect to absence from football) differed from the time loss injury definition used in the present study. Consequently, the injury rates reported are higher in these studies with incidences between 73 and 113 injuries per 1000 match hours in men and between 39 and 70 injuries per 1000 match

hours in women [16, 17, 18]. However, in some FIFA tournaments, injury rates according to expected time loss were also reported. The expected time loss injury rates either correspond very well or are only slightly higher (24-51 injuries per 1000 match hours) than the rates found in our study (30-36 injuries per 1000 match hours) [16, 17, 18]. The match injury incidence in our study is also very similar to that previously reported for a men's senior national team [6].

The present survey is the first evaluating training injury incidence during an international championship. The incidence of training injury was very low in all three championships compared to the time loss injury rates (2.3-11.8 injuries per 1000 training hours regardless of the playing level) reported in the literature [2, 5, 6, 11, 12, 13, 22, 25, 26]. The most plausible explanation is that training at international tournaments is mainly devoted to tactics and recovery in contrast to high intensity exercises during the regular league season.

Non contact injury

In the F-MARC studies of the women's World Cup 1999 and the Olympic Games 2000 and 2004, the frequency of non contact injury was between 16 and 21% of all match injuries [17, 18]. In the men's Olympic Games 2004, this figure was as low as 14% [18], but in the men's World Cup 2002 twenty-seven per cent of the match injuries occurred without contact with another player [16].

In the present study, as many as 48% of all injuries and 41% of all match injuries resulted without contact. The risk of sustaining an injury without contact with another

player is thus high in international football and may also be of increasing importance. One explanation for the high incidence of non contact injury found is probably the high frequency of muscle injuries in today's football [3, 11, 12, 17, 25, 26]. Thigh strain was the most common injury subtype in the current study and no case involved contact. In contrast, overuse injuries were quite uncommon and did not contribute significantly to the number of non contact injuries. This finding agrees well with the F-MARC studies where even lower overuse injury rates were identified [16, 17]. However, considerably higher overuse injury frequencies have been reported in studies on league play at the highest club competitive level [12, 25, 26], which could be explained by the fact that overuse injuries are often recurrent in nature. However, it is also possible that players with ongoing complaints before the championships might not have been selected for international duty. Alternatively, players might be able to play fully during the championships without any time loss in spite of some physical complaints. The low intensity of the training during the tournaments was probably also a factor contributing to the low frequency of overuse injury.

In this study, non contact injury was significantly more common in the second half possibly reflecting fatigue, although this is controversial and the evidence is poor [21]. However, hot dry summer weather, short periods of rest between matches and the burden of a long league season prior to the championship might contribute to increased fatigue amongst players. A congested match calendar at the end of the European league season 2001-2002 may have contributed to the high number of injured players during the men's World Cup 2002 [7, 16]. It can thus be hypothesised that a longer recovery

period from league play and/or careful preparation prior to international championships could lead to a reduction in the number of non-contact injuries.

Men's vs. women's international football

In the present study, no difference in overall injury incidence could be shown between men's and women's international football. This is in agreement with other studies which have found either a similar or a slightly lower risk of injury among female top level footballers [10, 17, 18, 20]. However, female teams that were eliminated in the group stage had a significantly higher match injury incidence compared to the teams that went on to the final stage. No difference was seen in the men's championships which suggests that injuries sustained have a greater influence on a team's success in women's football. Although increasing in popularity, women's football still has few licensed players and greater heterogeneity within the sport. The higher injury rate among the eliminated female teams could have several explanations. First, injury may have a direct influence on the match result, since the best players are selected to play and the team is weakened if a player is injured. Second, injury could also have an indirect impact on the match result, since tactics are disturbed if a player in the initial line-up is substituted because of injury. Third, teams qualifying to the final stage may have been in better physical condition with a lower liability for injury. Finally, squads that are more dependent on the health status of certain key players may have a higher threshold to rest these players even if they have ongoing physical complaints or fatigue which could make them more injury prone.

Injury severity

Twenty per cent of the injuries were severe causing absence from football of a month or more. This is higher than proportions (10-15%) reported in studies on national league play [8, 10, 11, 12, 20, 25, 26]. The higher proportion found in our study is probably explained by the high intensity, the competitive nature and the importance of each match during international championships. However, lower proportions of severe injury (3-7%) were expected in the F-MARC studies on the World Cup 2002 and Olympic Games 2004 [16, 18], but it is possible that the severity of an injury may be underestimated when examining a player during or immediately after a match.

Almost seven weeks on average were spent in rehabilitation for each severe injury implying that the severely injured players were unable to play with their clubs for most of the preseason preparation period (July and August). This may, as a result, have consequences for the success of the club as well as for the player's fitness, performance and liability for recurrent injury.

Methodological considerations

The fundamental problem of previous football and other sports injury surveillance research has been the lack of agreement between the studies regarding study design, injury definition, data collection procedures and observation periods [9, 13, 14, 15, 19]. Recently, a methodological consensus statement was published in an effort to minimise this bias and to introduce guidelines for future research [9]. The methodology used in the present study is specifically developed for football and has been implemented as a matter of routine in several studies over recent years [13]. General agreement with the

consensus guidelines is good, but it had to be modified in some minor aspects. For instance, the classification of injury type, injury location and injury severity was fully adopted, but it was not possible for us to document individual details of pre-match warm ups and post-match cool downs which has been recommended [9].

A limitation of the present study is that thirty-two different team physicians were involved in delivering the data. Due to the setting of the study, it was not possible to analyse the inter-observer reliability. However, all team physicians were provided with a detailed manual to ensure a reliable data collection. The forms were also checked immediately by the investigators for any missing or unclear data followed by prompt feedback to the teams. With this system any doubtfulness could be clarified in each case.

Another limitation is that the power was too low to detect any significant differences between the sexes for the most common injury subtypes. However, some studies have found a different injury pattern between women's and men's football, for instance regarding anterior cruciate ligament injuries [1, 24], but such studies need considerably larger study samples and longer observation periods.

The advantage of including training injuries in this study is that a total picture of the injury characteristics of the championships is obtained. Compared to match exposure, which can easily be obtained from official match records, the collection of individual training exposure data usually creates a greater workload for the recorders. However, this is much easier when studying a single championship since training sessions are

fewer and the observation period is short. Our study showed a considerable variation in both the frequency and degree of training between teams in all three championships with the highest figures in WOCO 2005. However, the incidence of injury during training was not significantly different between championships. This may be due to differences in the specific type of training performed (i.e. football specific exercises, weight training, endurance training, recovery sessions etc.), but this was not recorded in the present study. This issue needs to be addressed in future studies evaluating exposure and injuries during training, since the risk of injury is logically higher on the football pitch compared to recovery in the pool or in the gym. This is also illustrated by the finding that for almost all categories of injury severity, the incidence of injury was significantly lower during training than during match play.

Conclusions

In this prospective study on three European Championships in football, we found no differences in the injury incidence between the tournaments. However, eliminated teams in the women's championship had a higher match injury incidence than teams going to the finals. Finally, the frequencies of non contact injury and severe injury were higher than previously reported in similar studies and is a worrying finding.

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Table 1. Exposure and injury characteristics in three European Championships in football during 2004-2005

	EURO 2004	WOCO 2005	U-19 2005
Study period	June 12 to July 04	June 05 to June 19	July 18 to July 29
No. of matches	31	15	15
No. of teams	16	8	8
No. of players	368 (23 players/team)	160 (20 players/team)	144 (18 players/team)
No. of injured players	40/368 (11%)	17/160 (11%)	16/144 (11%)
Exposure	4742 hours	1820 hours	1394 hours
- training	3694 hours (78%)	1314 hours (72%)	899 hours (64%)
- match	1048 hours (22%)	507 hours (28%)	495 hours (36%)
No. of injuries	45	18	17
- training	7/45 (16%)	3/18 (17%)	2/17 (12%)
- match	38/45 (84%)	15/18 (83%)	15/17 (88%)
Mean (SD) injury incidence	10.1 (10.5)	11.6 (11.4)	13.4 (12.0)
- training	2.1 (2.7)	2.5 (3.6)	2.9 (8.2)
- match	36.0 (35.0)	36.0 (39.0)	30.4 (24.6)
Circumstances			
- traumatic injuries	36/45 (80%)	15/18 (83%)	16/17 (94%)
- overuse injuries	9/45 (20%)	3/18 (17%)	1/17 (6%)
- non contact injuries	21/45 (47%)	7/18 (39%)	10/17 (59%)
- non contact match injuries	15/38 (39%)	5/15 (33%)	8/15 (53%)
- foul play injuries	11/30 (37%)	2/12 (17%)	4/14 (29%)
Injury severity			
- slight	0/45 (0%)	3/18 (17%)	0/17 (0%)
- minimal	21/45 (47%)	8/18 (44%)	8/17 (47%)
- mild	6/45 (13%)	0/18 (0%)	3/17 (18%)
- moderate	6/45 (13%)	4/18 (22%)	5/17 (29%)
- severe	12/45 (27%)	3/18 (17%)	1/17 (6%)
- career ending	0/45 (0%)	0/18 (0%)	0/17 (0%)

Table 2. Number and combined categories of injuries in three European Championships in football during 2004-2005

	EURO 2004	WOCO 2005	U-19 2005
Head/neck			
- concussion	0	1	0
Trunk			
- strain/muscle rupture	0	0	1
- fracture	1	0	0
- haematoma/contusion/bruise	1	0	0
- other injury	1	0	0
Shoulder			
- sprain/ligament rupture	2	0	0
Arm			
- fracture	2	0	0
- haematoma/contusion/bruise	0	1	0
Hip/groin			
- strain/muscle rupture	5	0	1
- haematoma/contusion/bruise	0	0	1
Thigh			
- strain/muscle rupture	4	2	4
- haematoma/contusion/bruise	5	1	0
- other injury	1	0	0
Knee			
- sprain/ligament rupture	2	2	1
- tendon injury/rupture/bursitis	1	0	0
- haematoma/contusion/bruise	1	2	1
- other injury	1	0	0
Lower leg			
- strain/muscle rupture	1	1	0
- tendon injury/rupture/bursitis	1	0	0
- haematoma/contusion/bruise	2	3	0
- laceration/abrasion/blister	1	0	0
- other injury	0	0	1
Ankle			
- sprain/ligament rupture	6	1	3
- haematoma/contusion/bruise	1	1	2
- other injury	0	1	0

Foot

- sprain/ligament rupture	0	0	1
- fracture	1	2	0
- haematoma/contusion/bruise	0	0	1
- laceration/abrasion/blister	5	0	0

Table 3. Injury severity in three European Championships in football during 2004-2005

	Training	Match	P-value
Slight			
- No. of injuries	3	0	
- Mean (SD) injury incidence	0.6 (2.0)	0	0.11
Minimal			
- No. of injuries	1	36	
- Mean (SD) injury incidence	0.1 (0.6)	18.9 (30.4)	0.0012
Mild			
- No. of injuries	0	9	
- Mean (SD) injury incidence	0	4.2 (9.6)	0.028
Moderate			
- No. of injuries	3	12	
- Mean (SD) injury incidence	0.9 (4.2)	6.6 (10.4)	0.028
Severe			
- No. of injuries	5	11	
- Mean (SD) injury incidence	0.8 (2.0)	4.9 (8.1)	0.0076
Career ending			
- No. of injuries	0	0	
- Mean (SD) injury incidence	0	0	--