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Injury surveillance in male professional football; is medical staff reporting complete and accurate?

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Since the 2000 season, an injury surveillance system has been established to monitor injury risk and injury patterns in the Norwegian professional football league. The aim of this study was to assess the accuracy of routine injury registration performed by medical staff in professional football. The team medical staff completed injury registration forms on a monthly basis throughout the 2007 season (January–October). Players were interviewed at the end of the season (October/November) about all injuries that occurred from July through September. Thirteen of fourteen teams, 296 of 310 A-squad players were interviewed. An injury was recorded when a player was unable to take fully part in football training or match the day after injury. A total of 174 injuries were registered, 123 acute injuries and 51 overuse injuries. Of these, 141 were reported by medical staff and 122 by players. Eighty-nine injuries (51%) were registered using both methods, 52 (30%) by medical staff only and 33 (19%) by player interviews only. Prospective injury surveillance by team medical staff in Norwegian male professional football underestimates the incidence of time-loss injuries by at least one-fifth.

Over the last three decades, many different injury definitions and methods have been used to record injuries among football players, leading to a significant discrepancy in the injury incidences reported (Fuller et al., 2006a, b, c), The incidence of time-loss injuries reported from studies in elite football varies from 15.8 to 34.8 per 1000 match hours, and 2.3 to 5.9 per 1000 training hours (Nielsen & Yde, 1989; Arnason et al., 1996; Hawkins & Fuller, 1999; Waldén et al., 2005).

Professional football players are employees, and therefore covered by the same health and safety legislation as other workers (Fuller, 1995). Injury registration is a key risk management tool; injury incidence and patterns must be known to be able to intervene on modifiable risk factors. Injury incidence is not only dependent on the injury definition in use, but the registration method will also have a significant impact on the injury incidence reported (Inklaar, 1994; Dvorak & Junge, 2000; Fuller et al., 2006a, b, c).

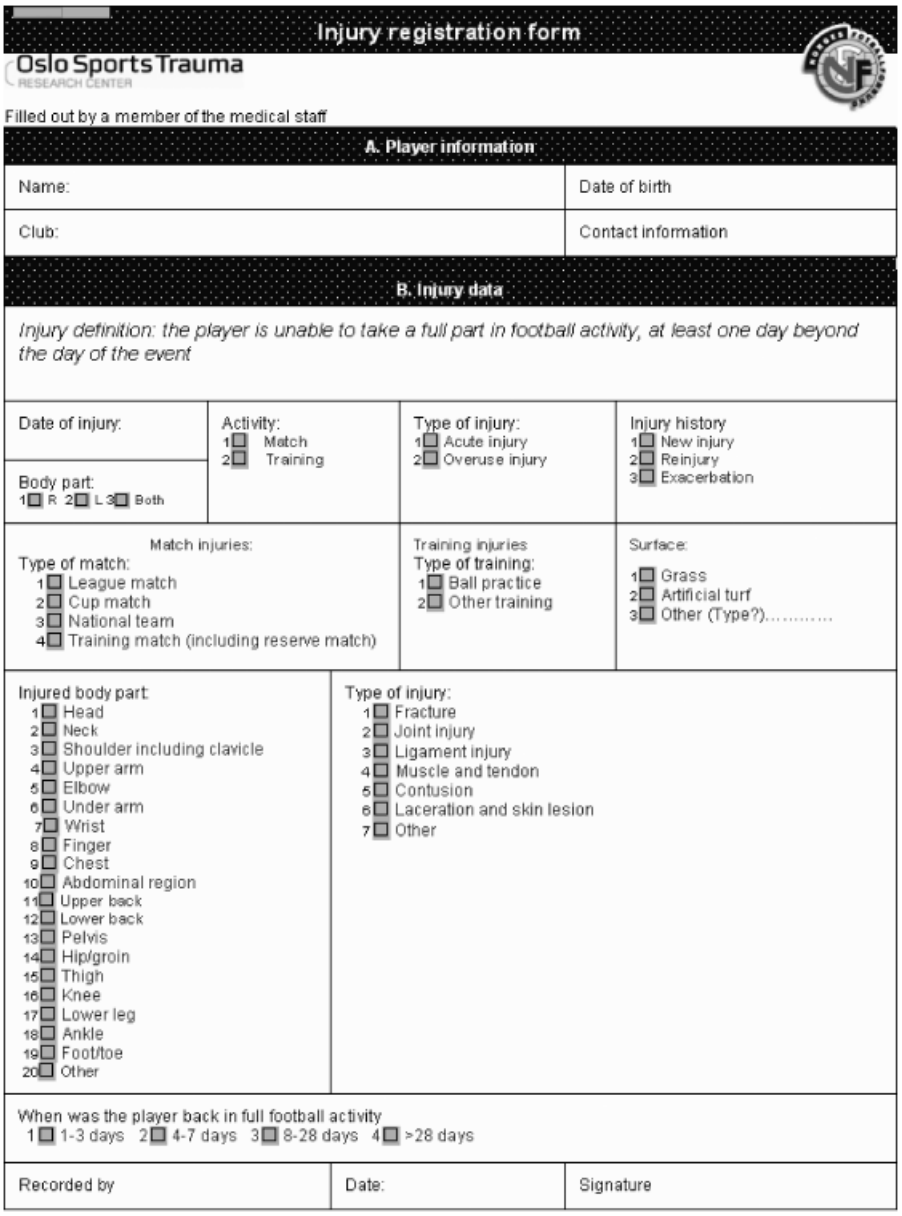
A consensus statement on injury definitions and data-collection procedures for studies of injuries in football from 2006 emphasized that injury registration should be carried out prospectively and conducted by a member of the medical staff (Fuller et al., 2006a, b, c). However, the methodological implications of these recommendations have not been studied previously. The reliability and validity of injury registration has been emphasized as a field that needs further investigation (Hägglund et al., 2005).

A study by Junge and Dvorak (2000) from Czech football found that retrospective interviews only captured 1/3 of what was recorded prospectively by a physician visiting the teams once a week during the season. However, it is not known whether a routine injury surveillance system captures all time-loss injuries suffered by players. We therefore designed this study to compare prospective injury registration by team medical staff with structured, retrospective player interviews.

Materials and methods

Study design and population

The Norwegian male professional league (Tippeligaen) consists of 14 football clubs, representing the highest level of play in Norway among males. As part of a continuous prospective injury registration system that was established in 2000 (Andersen et al., 2004), the medical staff of each club recorded all injuries sustained by players with a first-team contract throughout the 2007 season (January–November) for the prospective part. We invited all players with a first-team contract to participate in the study, but did not include players on trial or youth players without a professional contract. We interviewed the players in October about all injuries that occurred during three of the final months of the season (i.e. from July through September of the same year).



Injury registration form

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Filled out by a member of the medical staff

A. Player information

Name:	Date of birth
Club:	Contact information

B. Injury data

Injury definition: the player is unable to take a full part in football activity, at least one day beyond the day of the event

Date of injury:	Activity: 1 Match 2 Training	Type of injury: 1 Acute injury 2 Overuse injury	Injury history 1 New injury 2 Reinjury 3 Exacerbation
Body part: 1 R 2 L 3 Both			

Match injuries: Type of match: 1 League match 2 Cup match 3 National team 4 Training match (including reserve match)	Training injuries Type of training: 1 Ball practice 2 Other training	Surface: 1 Grass 2 Artificial turf 3 Other (Type?).....

Injured body part: 1 Head 2 Neck 3 Shoulder including clavicle 4 Upper arm 5 Elbow 6 Under arm 7 Wrist 8 Finger 9 Chest 10 Abdominal region 11 Upper back 12 Lower back 13 Pelvis 14 Hip/groin 15 Thigh 16 Knee 17 Lower leg 18 Ankle 19 Foot/toe 20 Other	Type of injury: 1 Fracture 2 Joint injury 3 Ligament injury 4 Muscle and tendon 5 Contusion 6 Laceration and skin lesion 7 Other

When was the player back in full football activity
1 1-3 days 2 4-7 days 3 8-28 days 4 >28 days

Recorded by	Date:	Signature

Fig. 1. Injury form used for both registration methods.

The Regional Committee for Medical Research Ethics, Region Øst-Norge and the Norwegian Social Science Data Services approved the study.

Injury definition and injury form

We used a time-loss definition, in accordance with the consensus statement, when recording injuries; an injury was registered if the player was unable to take full part in football activity or match play at least 1 day beyond the day of injury (Fuller et al., 2006a, b, c). According to the onset of an injury, injuries were defined as acute or overuse, evaluated by the medical staff and the players. If the injury was the result of a specific, identifiable event, it was defined as acute. If the onset was gradual, without a single, identifiable event, it was reported as an overuse injury (Fuller et al., 2006a, b, c). We used the same injury registration form for the medical staff registration and the player interviews. We developed the form according to the consensus statement, including information about the date of injury, the type of activity (match or training) in which the injury occurred, injury location and injury history (Fig. 1). Injuries were categorized into four severity categories according to the duration of absence from match and training sessions: minimal (1–3 days); mild (4–7 days); moderate (8–28 days); and severe (>28 days). Players were defined as injured until they could take full part in first-team football training or match play (Fuller et al., 2006a, b, c).

Injury registration by medical staff

A member of the club medical staff performed the prospective injury registration, in most cases the physiotherapist, but in some cases the team physician. We sent a manual with

instructions on how to conduct the injury registration to the medical staff at the start of each season. The club license in Norway requires that a physiotherapist attend each football activity, training and matches. In addition, at least one physician, usually from the home team, must attend all games. Forms were collected on a monthly basis and, if needed, we followed up with reminder text messages and phone calls. We checked the injury cards thoroughly when we received them. If information was missing or any other inconsistencies were seen, a member of the study group contacted the medical staff to resolve this. The team medical staff was kept unaware of the player interview sessions that we planned to conduct after the end of the season.

Player interviews

Most of the clubs were interviewed in October, usually in connection with team training or in the player hotel the day before a match. However, for clubs participating in UEFA

Injury surveillance -player interview

Viking

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Injury defintion: the player was unable to take a full part in football activity at least one day beyond the day of injury

Player name _____

Nation _____

Contact information _____

Week	Date	Site	Activity	Participated: Yes	Injury: Yes	If "yes" on injury, fill out form. Other notes:
		Mid season training	Training	☐	☐	
29	21.07.2007	Rosenborg (A)	☐	☐	☐	
16-22.7			Training	☐	☐	
30	25.07.2007	Brann (H) - cup	☐	☐	☐	
	30.07.2007	Start (H)	☐	☐	☐	
23-29.7			Training	☐	☐	
31	05.08.2007	Sandefjord (A)	☐	☐	☐	
30.7-5.8			Training	☐	☐	
32	12.08.2007	Fredrikstad (H)	☐	☐	☐	
6-12.8			Training	☐	☐	
33	18.08.2007	Odd (A) - cup		☐	☐	
13-19.8			Training	☐	☐	
34	26.08.2007	Odd (A)	☐	☐	☐	
20-26.8			Training	☐	☐	
35	02.09.2007	Lillestrøm (H)	☐	☐	☐	
27.8-2.9			Training	☐	☐	
36				☐	☐	
3-9.9			Training	☐	☐	
37	16.09.2007	Lyn (A)	☐	☐	☐	
10-16.9			Training	☐	☐	
38	23.09.2007	Aalesund (H)	☐	☐	☐	
17-23.9			Training	☐	☐	
39	30.09.2007	Strømsgodset (H)	☐	☐	☐	
24-30.9			Training	☐	☐	

Number of injuries:_____ Number of injury forms:_____

Fig. 2. Example of interview form with a week-by-week schedule. The form was used to facilitate player recall, and for each week, the player was asked "did you participate fully in all first team training sessions during that week?" and "were you selected in the squad for the match?" If no, then he was asked whether that was due to a football-related injury, and if so, an injury form was completed.

competitions after the regular season, we conducted some player interviews during early November. Twelve telephone interviews were carried out with players not present during the team interview sessions. Physicians and medical students from the Oslo Sports Trauma Research Center completed one-on-one interviews based on a structured interview form that was first developed for volleyball (Bahr & Reeser, 2003) and later also used in World Cup skiing (Florenes et al., 2009). The interviewers were blinded to the data from the prospective injury registration. To facilitate player recall, the interviews were based on a week-by-week schedule of each club's training and match program for the three-month study period (Fig. 2). Player interviews were conducted one on one in quiet and private surroundings. The players were asked whether they participated fully in first-team training and were available for match selection each week. They were also asked whether or not they were selected for the match squad. If they did not participate fully in training or were not selected, we asked whether they had an injury during that period. If a player reported an injury, we informed him about how we defined an injury and asked when he was able to participate fully in football training. We completed the same injury registration form as that used by the medical staff registration.

Media monitoring

A member of the study group monitored the homepage of each club, the local newspaper and the match previews in the largest national newspapers prospectively. This was done to double check the information provided in the player interviews and reported by the medical staff. We also checked that players claiming to have been injured did not appear on the match roster during the period in question.

Statistics

Kappa correlation coefficients were calculated for agreement between methods (Altman, 1991). Coefficients of 0.81–1.00 are generally interpreted as very good, 0.61–0.80 as good, 0.41–0.60 as moderate, 0.21–0.40 as fair and <0.20 as poor (Altman, 1991).

Results are presented by comparing information reported from medical staff with that reported in the retrospective player interviews.

Results

Thirteen of the 14 clubs in Tippeligaen completed the study, while one club had to be excluded because the medical staff had not provided any information before the player interviews. Of 310 eligible players, 296 (95%) were interviewed and included in the study. Of the 14 players not participating in the study, six had language problems, seven players were absent from the training session the day the study group visited the club and did not respond to subsequent phone calls. One player declined the invitation to participate.

During the 3-month study period, 133 (45%) of the players sustained at least one injury, and a total of 174 unique injuries were registered. Of these, 19% were only recorded through the player interviews, 51% by both the interviews and the medical staff registration and 30% only through the medical staff registration (Table 1). All of the injuries reported by the players only corresponded with media reports and match records. Of the 123 acute injuries, 19% were only recorded through the player interviews, 54% by both methods and 28% only through the medical staff registration. Of the 51 overuse injuries, the corresponding figures were 20%, 45% and 35%. The total acute injury incidence reported through medical staff registration was 4.9 injuries per 1000 playing hours and 4.3 through player interviews. The acute match injury incidence was 17.9 vs 16.1; the acute training injury incidence was 2.4 and 2.1, respectively. Of injuries occurring during July, 42% were only recorded by the medical staff (not recalled by players). For the months of August and September, the proportions were 35% and 20%, respectively.

Of the 89 injuries recorded by both methods, 64 (72%) had corresponding severity classifications (Table 2). Of the 33 injuries that were not reported by the medical staff, 16 (49%) were minimal, nine (27%) mild, seven (21%) moderate and one (3.0%) severe. Of the 52 injuries that were reported by the medical staff only, 19 (37%) were minimal, 19 (37%) mild and 14 (27%) moderate.

Of the 89 injuries that were reported by both the medical staff and through player interviews, all but two were reported as the same injury type (Table 3). Injuries to muscle and tendons (both acute and overuse injuries) were the injury types most frequently missed in both the medical staff registration and the athlete interview (67% and 56%, respectively).

When comparing the body part injured as reported by the medical staff with that reported by the athletes, 88 out of 89 injuries were identical (Table 4). The most frequent type of injury missed was thigh injuries, constituting 15 (46%) of the injuries that the medical staff did not report and 15 (29%) of those not reported by the athletes.

When comparing information from the 66 acute injuries reported by both the medical staff and the athletes, 59 (89%) had corresponding information regarding type of activity when the injury was sustained (Table 5). The medical staff reported 100 of the 123 acute injuries identified during the study period; of the 23 injuries missing, nine (39%) were sustained during league matches, three (13%) during training matches (including reserve games) and 11 (48%) during ball practice.

For injuries recorded through both methods, the kappa correlation coefficients for agreement between the medical staff report vs the player interviews were 0.61 (95% CI 0.48–0.74) for injury severity, 0.97 (0.92–1.01) for injury type, 0.99 (0.96–1.01) for

body part injured and 0.89 (0.79–0.98) for activity when injured.

Discussion

The aim of this study was to assess the accuracy of a prospective injury registration system based on medical staff reporting by comparing it with retrospective player interviews. The main finding was that medical staff reports underestimated the incidence of time-loss injuries by 19% for the 3-month study period as a whole. The study also showed that 30% of the injuries registered by the medical staff were not reported by the players, indicating that there is a significant recall bias associated with retrospective player interviews. Player recall appeared to deteriorate month by month.

That more injuries are recorded by prospective injury registration compared with retrospective interviews is in accordance with previous studies from football, preschool children and among physical education students (Twellaar et al., 1996; Junge & Dvorak, 2000; Fonseca et al., 2002). Prospective injury registration is not complete, but the reliability of retrospective injury registration is even poorer (Twellaar et al., 1996). Czech football clubs were followed for 1 year by a physician each week to record injuries among their players, and in addition, the players were asked to fill out a questionnaire after the 12-month season (Junge & Dvorak, 2000). They found that there is significant recall bias associated with retrospective player interviews, especially regarding mild injuries sustained close to 1 year in the past (Junge & Dvorak, 2000). In an attempt to minimize the effect of recall bias during the player interviews, we limited the study period to 3 months. However, it should be noted that as some players were not interviewed until mid-November, they had to recall injuries that may have occurred as much as 4.5 months back in time. The period July through September was chosen in order to ensure that the players were available for interviews during the final weeks of the season. The competitive season ended in the beginning of November, and most clubs give their players a 4- to 6-week training holiday after this. In order to optimize the interview, we used a structured format based on the team schedule to facilitate recall and focused on the player–interviewer relationship and interview setting. The players were thoroughly informed about confidentiality and the interviews were conducted one-on-one and in private. Despite these measures, 30% of the injuries reported by team medical staff for the 3-month study period were not recalled by the players.

Table 1. Comparison of injuries recorded through medical staff reports, player interviews or both methods

	Medical staff	Both methods	Player interview
All injuries	52	89	33
July	16	18	4
August	21	28	11
September	15	43	18
Acute injuries	34	66	23
Overuse injuries	18	23	10

Table 2. Comparison of severity information between medical staff reports and player interviews

Medical staff	Player interview					
	1–3 days	4–7 days	8–28 days	>28 days	Not recorded	Total
1–3 days	4	6			19	29
4–7 days	5	17	4		19	45
8–28 days		2	24	6	14	46
>28 days			2	19		21
Not recorded	16	9	7	1		33
Total	25	34	37	26	52	174

Results are shown as the number of cases in each severity category, classified according to the number of days of absence from training and match play.

Table 3. Comparison of injury type classification between player interviews and medical staff reports

Medical staff	Player interview							
	Fracture	Joint/ligament	Muscle/tendon	Contusion	Skin/laceration	Other	Not recorded	Total
Fracture	9							9
Joint/ligament		20	2				13	35
Muscle/tendon			46				29	75
Contusion				9			9	18
Skin/laceration							1	1
Other						3		3
Not recorded	1	2	22	6	1	1		33
Total	10	22	70	15	1	4	52	174

Table 4. Information on localization of injury from player interviews compared with information provided by medical staff

Medical staff	Player interview												
	Head	Neck	Shoulder	Chest	Lower back	Hip-groin	Thigh	Knee	Lower leg	Ankle	Foot	Not recorded	Total
Head	3											1	4
Neck												1	1
Shoulder			1									3	4
Chest				2								1	3
Lower back					5							3	8
Hip-groin						14						4	18
Thigh						1	19					15	35
Knee								13				6	19
Lower leg									10			9	19
Ankle										11		8	19
Foot											10	1	11
Not recorded	2			1	1	5	15	1	4	2	2		33
Total	5	0	1	3	6	20	34	14	14	13	12	52	174

Table 5. Comparison of activity between player interviews and medical staff registration on type of activity when the injury was sustained

Medical staff	Player interview						Total
	League match	Cup match	National team	Training match	Ball practice	Not recorded	
League match	24	2				12	38
Cup match	1	3				2	6
National team			2				2
Training match				7	1	6	14
Ball practice	2			1	23	14	40
Not recorded	9			3	11		23
Total	36	5	2	11	35	34	123

Our study is the first to validate the accuracy of an established injury surveillance system based on registration by regular team medical staff in professional football. In contrast, Junge and Dvorak (2000) had a member of the research group travel to each club each week to register injured players. These data were then, after the end of the season, compared with retrospective interviews. As noted, retrospective player interviews are limited by recall bias, and therefore cannot be used as a ''gold standard.'' Rather, the question was whether players did recall injuries that had not been recorded through the injury surveillance system. Indeed, for the 3-month study period, we found that the medical staff reports underestimated the incidence of time-loss injuries by 19%. Another interesting observation was that player recall deteriorated with time; the proportion of injuries that were only reported through the player interviews increased from July (11%) to September (24%). Therefore, the true injury incidence may be underestimated by more than 24%.

The aim of the study was to examine whether routine injury surveillance produces complete and accurate data. In order to ensure that the medical staff registration was not influenced by prior knowledge of the validation study, our study was introduced to the medical staff and players only after the September injury data had been collected. This was also the first verification of data quality since the injury surveillance system was started in 2000. We therefore believe that the data are representative for the quality that can be expected from day-to-day routine surveillance.

Junge and Dvorak (2000) found that the localization and circumstances of injury were similar in both the prospective and the retrospective data collection. In our case, for injuries captured by both recording methods, the agreement was very good for the categories body part injured, activity when injured and injury type and good for severity. However, as can be seen from Table 2, when there was a discrepancy between the player and the medical staff reports regarding severity, in 16 cases, the player reported a longer absence than the medical staff, while there were only nine cases where medical staff reported longer absence. Certainly, some of this is a problem of recall; we asked players to recall injuries that may have occurred up to 4.5 months ago. Another source of bias may have been the interpretation of when an injured player returned to full participation. According to the injury definition, a player not able to participate fully should be reported as being in rehabilitation, i.e. as injured. In the interviews, we clarified the ''fully fit'' criterion clearly for the player when recording an injury, and there are certainly cases where the medical team may have cleared a player for full participation but in retrospect the player reported during the interviews that in

fact he was not participating fully, at least initially. However, the results show that the main challenge with injury surveillance is to get the medical staff to fill out the injury form in the first place. When they do, the information appears to be correct.

The injury-surveillance manual requires clubs to submit their forms on a monthly basis. In our experience, there are differences between the clubs in their injury registration routines. Some clubs routinely complete the form on the day of injury, while others seem to fill out the forms once a month. Further evidence of this is that 76% of all injuries missed by the medical staff were injuries leading to an absence of less than one week; this indicates a possible recall bias by team medical staff of mild injuries. However, we were also surprised to see seven moderate and one severe injury went unreported by team medical staff. We do not know why these were not recorded, as they were obviously known to the medical team in the club. These injuries were all confirmed by the media monitoring and match records, and we therefore have no reason to believe that they were not genuine. Some clubs have several people involved in the injury registration, and in these cases, it is important to clarify the role and responsibilities of each in the injury surveillance system.

A limitation of the Norwegian injury surveillance system, as well as many epidemiological studies, is that exposure data are only collected on a team basis, i.e. the total number of players present during each practice. It has been recommended that exposure is recorded on an individual basis (Fuller et al., 2006a, b, c). This would allow the study group to control player attendance vs injury reports received, and should serve to increase the capture rate. Media monitoring is another possible source of information. Media often offer preview programs or websites with weekly information about all available and injured players. This media coverage service was used in this study to verify new injuries reported by the players. Faude and colleagues concluded from their study in German professional football that media-based injury statistics were almost complete; however, the diagnosis was not available in all cases.

Another option to improve the capture rate is to use web-based injury surveillance systems, which have been suggested as a solution to ensure the quality of injury registration. One important advantage of these is that the injury-surveillance component can be married to the player's medical record, and even the team schedule and roster. In this way, an injury form can be generated (semi)automatically whenever a patient record is entered into the system. However, it must be underlined that such a surveillance system must take into account the need for strict player confidentiality (Hägglund et al., 2005). An increased focus on medico-legal issues among sports medicine professional will also help to ensure that all patient encounters are recorded. A web-based program may also make it easier for medical staff to record injuries, with no need to bring paper forms, when for example on the road. Barriers include computer and internet access. However, in the near future, this will be less of a problem; increased wireless internet access and new computer devices (e.g. personal digital assistants, advanced cell phones) will facilitate the introduction of web-based recording systems.

Interestingly, medical staff recording is not necessarily the best injury registration method in all settings. A recent study among elite skiers and snowboarders found that only 61% of all recorded injuries were reported by the medical staff, and that only 6% of the injuries were missed by retrospectively player interviews (Florenes et al., 2009). This might be explained by the fact that in winter sports most of the teams and athletes travel continuously during the competitive season. It might therefore be difficult for team medical staff to register and send in injury reports on a regular basis. In contrast, football teams spend most of the week in their own training facilities, with team medical staff in attendance most of the time. Thus, injury registration systems should be tailored to the sports they are intended for, using different methods in different sports depending on the availability of medical staff.

In conclusion, prospective injury surveillance by team medical staff in Norwegian male professional football underestimates the incidence of time-loss injuries at least by one-fifth.

Perspectives

Professional football players are employees, and are therefore covered by the same health and safety legislation as other workers (Fuller, 1995). Injury surveillance is a key risk management tool to monitor injury incidence and injury patterns to ensure the safest possible work environment for the players. Today, injury registration is not compulsory for the clubs and medical staff. Implementation of injury registration as a requirement to be issued a club license by the national football association would ensure that this important risk management tool is in place. The accuracy of an injury surveillance system is the responsibility of the study group; it is therefore important to establish routines for ongoing education of the medical staff involved, regular feedback with injury statistics and close follow-up. During the European Championships, the team doctor is contacted every third day, to obtain a high response rate and clarify reporting procedures (Waldén et al.,

2007). In FIFA tournaments, the injury forms are collected after each match by a medical officer of the FIFA-Medical Assessment and Research Centre (Junge et al., 2004). We recommend that daily exposure is recorded for each individual player, as this allows both team medical staff as well as the study group to verify absences and injury reports. Computer-based systems could be programmed to flag discrepancies automatically.

Key words: football, athletic injuries, epidemiology, methodology.

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