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Incidence and Nature of Medical Attendance Injuries in English Community Rugby Union

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Investigation performed at the University of Bath, Bath, UK

Background: Previous research has identified injury patterns during community-level rugby union match play, but none have investigated the frequency and reasons for on-field injury management.

Purpose: To establish the frequency, reasons, and patterns of on-field injury management in English community rugby, including differences between different levels of play.

Study Design: Descriptive epidemiology study.

Methods: Over 3 seasons, injury information was collected from 46 (2009-2010), 67 (2010-2011), and 76 (2011-2012) English community clubs (Rugby Football Union [RFU] levels 3-9). Club injury management staff reported information for all medical attendances during match play, including details on the injury site and type, playing position (seasons 2010-2011 and 2011-2012 only), and whether the player was removed from play. Clubs were subdivided into groups A (RFU levels 3 and 4 [mainly semiprofessional]; n = 39), B (RFU levels 5 and 6 [mainly amateur]; n = 71), and C (RFU levels 7-9 [social and recreational]; n = 79) to differentiate playing levels.

Results: The overall medical attendance incidence was 229 per 1000 player-match hours (95% CI, 226-232), with 45 players removed per 1000 player-match hours (95% CI, 44-46). Attendance incidence for group A (294 per 1000 player-match hours; 95% CI, 287-301) was higher compared with group B (213; 95% CI, 208-218; $P < .001$) and C (204; 95% CI, 200-209; $P < .001$). There was a higher incidence of attendances to forwards (254; 95% CI, 249-259) compared with backs (191; 95% CI, 187-196; $P < .001$). The head was the most common specific site of injury (55 per 1000 player-match hours; 95% CI, 53-57) but the lower limb region overall accounted for most attendances (87; 95% CI, 85-89) and the greatest chance of removal from the pitch (22; 95% CI, 21-23).

Conclusion: With the likelihood of 1 injury for each team per match severe enough for the player to leave the pitch and with at least 1 attendance for a head injury per match, there is clear evidence that pitch side staff should be trained to recognize potentially serious injuries.

Keywords: epidemiology; sports medicine; injury surveillance

Rugby union (rugby) is one of the world's most popular team sports and is gaining further popularity, with a 19% increase in playing population between 2007 and 2011.⁶ Rugby match play is characterized by periods of low-intensity activity interspersed with bouts of high-

intensity running and contact events whereby opposing players engage in physical confrontations.²³ As a result of collision events in rugby union, the risk of time loss due to injury is similar to that for rugby league⁸ and in the Australian Football League¹⁸ but higher when compared with semicontact team sports such as soccer¹³ and field hockey.¹⁷

There is a growing body of literature describing the nature of match injuries in rugby union,^{1-5,7,9,12,14,26,27} but research conducted to date has focused primarily on time-loss injuries to international,^{2,4,12} professional,^{1,5,12,14,27} and youth^{9,19} players. There is limited literature relating to community rugby union,^{3,7,23,26} yet the vast majority of male senior rugby players in all nations participate at the community level, with English rugby comprising the largest community playing population in the world, with approximately 131,000 registered senior males playing every week.⁶

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Some studies of injury in community rugby have combined results for medical attention (or non-time loss) injuries (any injury requiring the player to seek medical assistance) and time-loss injuries (injuries causing the player to miss training or match play),^{3,26} but no studies have yet reported specifically on the nature of match play injuries requiring medical attendances, which may or may not result in a time-loss injury. Reporting medical attendances as a separate injury category is important because there are likely to be different types and frequencies of injury patterns when medical attention injuries are compared with time-loss injuries. While the incidence of moderate time-loss injuries (a severity of at least 8 days' absence) sustained in community rugby union equates to approximately 1 in every 3 matches,²³ there will be a higher incidence of less severe match play injuries that require medical attendances, although the extent of this is yet to be elucidated. Understanding more about all injuries requiring a medical attendance helps to shape policy in terms of training for pitch-side injury management staff and the provision of appropriate first aid equipment.

Higher playing levels within the community rugby structure have a higher incidence of time-loss injuries.²³ Given this finding, playing level should also be considered as a factor when considering medical attendance injury patterns. The aim of this study was to describe the nature of medical attention injuries resulting from match play within different levels of English community rugby union and provide data to inform pitch-side first aid requirements.

MATERIALS AND METHODS

Participants

Senior male first-team squads at English community-level clubs participating in Rugby Football Union (RFU) competition within playing levels 3 through 9 were invited to participate in the study. Data were collected over 3 seasons (2009-2010, $n = 46$ [61 clubs at start of season]; 2010-2011, $n = 67$ [90 clubs at start of season]; 2011-2012, $n = 76$ clubs [104 clubs at start of season]). Clubs discontinued participation in the study either through choosing not to continue with participation or if compliance for reporting data was poor. Clubs were classified as group A (RFU levels 3 and 4 [the highest level of English community rugby, with many semiprofessional players]; $n = 39$), B (levels 5 and 6 [mainly amateur clubs]; $n = 71$), and C (levels 7-9 [mainly recreational and social clubs]; $n = 79$). It should be noted that these definitions are approximate and there would have been varied practices across clubs. Having been provided with information about the study, individual players could opt out from participation at any time without any consequences by informing the club medical staff who would then stop data collection on these players. Ethical approval for the study was granted by the institutional ethics committee.

Match Data and Medical Attendance Injuries

Within each club, a nominated person (the injury management staff member holding an accredited sports therapist qualification as a minimum) was responsible for recording the injury information. All staff were provided with detailed written instructions for the recording of injury information, and a follow-up phone call was made by the research team to clarify that the staff understood the instructions. During every first-team match, including league, friendlies, and cup matches, injury management staff at participating clubs recorded each time that a "medical attendance" was made for any injury-related reason. For any such instance, details were recorded about which match quarter the attendance was made (time of injury), playing position (seasons 2010-2011 and 2011-2012 only), whether the player was removed from play (including the player being removed to the blood bin in the event of a blood injury), and brief details of the body site and injury type using the top 2 levels of the Orchard Sports Injury Classification System codes.²² Any pitch attendance for a reason not associated with treating an injury (eg, providing drinks or attending to kit/strapping) was not reported.

Data Analysis

Playing positions were grouped as forwards and backs, then subdivided into front row (props and hooker), second row, back row (flankers and No. 8), scrum halves, inside backs (fly half and centers), and outside backs (wingers and full backs) as described previously.²³ Data are combined for seasons 2009-2010, 2010-2011, and 2011-2012 (seasons 2010-2011 and 2011-2012 only combined for playing positions). Injury incidence was recorded as the number of medical attendances per 1000 player-match hours of exposure, and 95% CIs were calculated based on Poisson distribution. Player hours of match exposure were calculated as the number of matches \times number of players per team \times match duration (in hours). Differences between groups were determined using a 2-tailed Z test for comparison of rates.¹⁵ A chi-square test was used to compare proportions. Differences were deemed to be statistically significant if $P \leq .05$. Outcome measures included attendance incidence, site and type of injury, timing, playing position, and whether the player was permanently removed from play.

RESULTS

Overall Medical Attendance Incidence

The overall incidence for medical attendances for all groups combined was 229 per 1000 player hours (95% CI, 226-232). Over 4635 team matches, 4185 players were removed from play (45 players removed per 1000 player-match hours; 95% CI, 44-46). Incidence for medical attendances was higher in group A clubs compared with group B and C (both $P < .001$) and higher in group B clubs compared with group C ($P = .014$) (Table 1). This was also reflected in the incidence of player removal from the pitch, with significantly

TABLE 1
Matches Played and Medical Attendances by Playing Level^a

Playing Level	Total Matches	Total Player-Match Hours	Total Medical Attendances	Attendances per 1000 Player-Match Hours (95% CI)	Mean Medical Attendances per Team per Match
All levels	4635	92,700	21,255	229 (226-232)	4.6
Group A	1130	22,600	6636	294 (287-301) ^b	5.9
Group B	1730	34,600	7364	213 (208-218) ^c	4.3
Group C	1775	35,500	7255	204 (200-209)	4.1

^aGroup A, mainly semiprofessional clubs; group B, mainly amateur clubs; group C, mainly social and recreational clubs.

^bSignificantly different versus groups B and C (both $P < .0001$).

^cSignificantly different versus group C ($P = .014$).

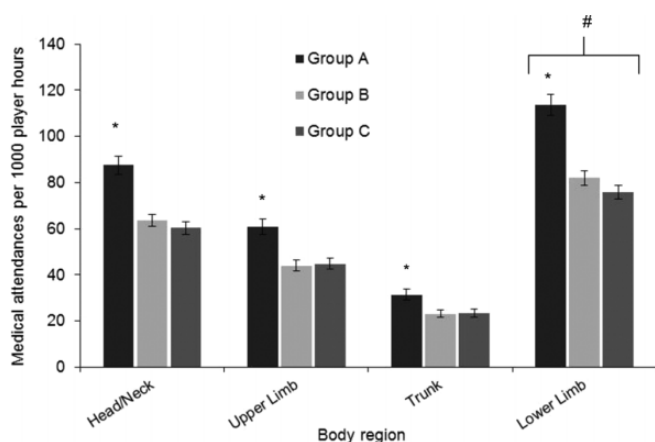


Figure 1. Incidence of medical attendances by body region for each group. *Significantly different versus groups B and C (all $P < .05$). #Significantly different versus all other body regions ($P < .001$). Group A, mainly semiprofessional clubs; group B, mainly amateur clubs; group C, mainly social and recreational clubs.

more in group A (54 attendances per 1000 player hours; 95% CI, 53-55) compared with groups B (43; 95% CI, 42-44) and C (42; 95% CI, 41-43; both $P < .001$). Players were removed permanently from play for 18%, 20%, and 20% of medical attendances for groups A, B, and C, respectively.

Anatomic Regions Injured

For all groups combined, there was a higher incidence of attendances (all $P < .001$) for injuries to the lower limb (87 attendances per 1000 player hours; 95% CI, 85-89) compared with the head/neck (68; 95% CI, 67-70), upper limb (48; 95% CI, 47-50), and trunk (25; 95% CI, 24-26) regions (Figure 1). Incidence of attendances was higher for all body regions in group A compared with groups B and C (all $P < .001$) (Figure 1). Attendances to the lower limb also resulted in the greatest chance of the player being removed from play (27% of all lower limb injuries removed) compared with all other body regions ($P < .001$). There was a greater chance of being removed for attendances to the trunk (22%) compared with the upper limb (19%; $P < .05$), while attendances to the head/neck (15%) resulted in lower

TABLE 2
Top 10 Anatomic Sites for Medical Attendances (All Playing Groups Combined)

Rank	Site	Attendances per 1000 Player-Match Hours (95% CI)	% of All Attendances	% of Injuries Removed
1	Head	55 (53-57)	24	14
2	Shoulder	23 (22-24)	10	25
3	Knee	22 (21-23)	10	28
4	Thigh	19 (18-20)	8	26
5	Ankle	18 (17-19)	8	27
6	Lower leg	18 (17-19)	8	22
7	Hand	14 (13-15)	6	11
8	Neck	13 (12-14)	6	17
9	Chest	11 (10-11)	5	19
10	Lower back	9 (8-9)	4	23

chance of removal compared with all other regions (all $P < .05$).

Specific Anatomic Sites Injured

Table 2 shows the incidence of medical attendances for all playing level groups combined when body regions are further divided into specific body sites. Overall, there were 55 attendances for head injuries per 1000 player hours (95% CI, 53-56), equating to at least 1 attendance for every team per match (Table 2) and 24% of the total injury count. The head injury rate was higher in group A (70 attendances per 1000 player hours; 95% CI, 66-74) compared with both B (52; 95% CI, 50-55) and C (48; 95% CI, 47-51) (both $P < .001$), and higher in group B clubs compared with group C ($P = .03$). The incidence for a player being removed from play as a result of a head injury was 8 per 1000 player hours (95% CI, 7-8), equating to 1 removal in every 7 head injury attendances (14% of all head injury attendances).

Injury Type

There was a significantly higher incidence of joint/ligament, muscle and tendon, contusion/laceration, and nerve/neural injuries in group A compared with groups B and C (all $P < .001$), while group B showed a higher

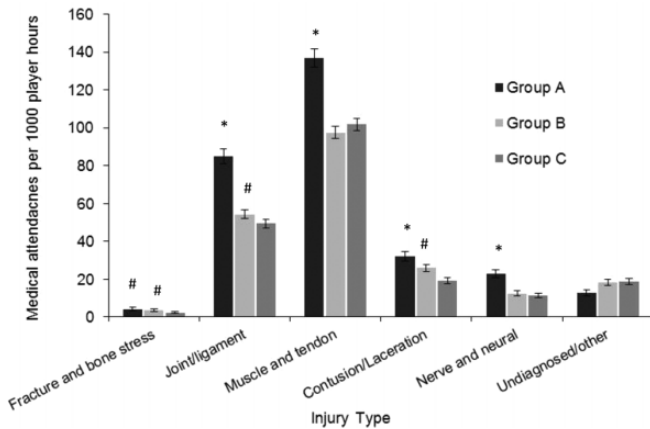


Figure 2. Incidence of medical attendances by injury type for groups A, B, and C. *Significantly different versus groups B and C (all $P < .001$). #Significantly different versus group C ($P < .05$).

incidence compared with group C for bone-related ($P = .004$), joint/ligament ($P = .004$), and contusion/laceration injuries ($P < .001$) (Figure 2).

Specific Injury Diagnoses

The 10 most prevalent medical attendance injuries are shown in Table 3. Head/face lacerations (including nose bleeds) accounted for 9% of all attendances (Table 3), a finding that was consistent in groups A (10%), B (10%), and C (8%). Nerve/neural injuries to the head accounted for 3% of all attendances and had the greatest chance of the player being removed (42% of all occasions). Concussions were not specifically reported because injuries were only coded as the site and general type, but it is anticipated that most of the head nerve/neural injuries were assessed further for potential concussions.

Playing Position (Seasons 2010-2011 and 2011-2012 Only)

Combining all playing levels, there was a higher incidence of attendances for forwards compared with backs ($P < .001$) (Table 4). When subdivided further into positional groups, there was a higher injury incidence in front row and back row forwards compared with second rows, scrum halves, inside backs, and outside backs (all $P < .05$). There was a higher incidence of injuries to second rows compared with inside backs ($P = .003$) and outside backs ($P < .0001$) and a lower incidence of attendances to outside backs compared with both scrum halves ($P < .0001$) and inside backs (all $P < .0001$). Both forwards and backs were removed from play for 20% of all attendances.

There were significantly higher injury rates to the forwards compared with the backs for all body regions (Table 4), with rate ratios of 1.6 (95% CI, 1.5-1.7) and 1.5 (95% CI, 1.4-1.6) for injuries in the head/neck and upper limb, respectively, for forwards compared with backs. For specific injuries, there was a significantly higher incidence of

shoulder ligament/joint injuries to forwards (7.2; 95% CI, 6.3-8.0) compared with backs (5.0; 95% CI, 4.3-5.8; $P < .001$) and more thigh strains in backs (6.4; 95% CI, 5.6-7.4) compared with forwards (3.5; 95% CI, 2.9-4.1; $P < .001$). There were significantly more head injuries for forwards (62.5; 95% CI, 60.0-65.1) compared with backs (42.9; 95% CI, 40.7-45.2; $P < .001$).

Attendances Made by Match Quarter

Combining all playing levels, there were significantly fewer medical attendances in the first match quarter (32; 95% CI, 31-34) compared with all other match quarters (all $P < .0001$) and fewer in the second (51; 95% CI, 49-52) compared with the third (60; 95% CI, 58-61; $P < .0001$) and fourth (53; 95% CI, 52-55; $P = .028$). There were significantly more attendances in the third quarter compared with all other quarters (all $P < .0001$).

DISCUSSION

This study identified the scale and nature of injuries requiring medical attention during English community-level rugby match play. There was a mean of 4.6 medical attendances for each team per match, with a higher incidence of attendances for higher playing levels (group A). For all levels, lower limb injuries had the greatest chance of the player being removed from play (27% of all injuries) and accounted for the highest incidence of attendances (87 attendances per 1000 player hours; 95% CI, 85-89), particularly in relation to joint/ligament injuries to the knee and ankle. Head injuries accounted for 24% of all medical attendances.

The overall incidence for medical attendances in community-level match play is 229 injuries per 1000 player-match hours. While the injury incidence reported in this study is higher than previously reported in other studies of community rugby,^{3,26} this may be the result of different injury definitions. In the current study, all medical attendances made by injury management staff were reported, regardless of the severity of the injury and whether this resulted in time loss. In other community rugby studies, injuries have been defined as those that required a player to seek medical attention without specifying whether this included all medical attendances during the match or just those severe enough for a player to seek assistance after the match.²⁶

There was a higher incidence of medical attendances in higher level clubs, which supports the findings from time-loss studies that injury incidence increases at higher playing levels.^{3,16,20,23} While the injury-causing event was not recorded in the current study, it is possible that this difference may be attributed to a greater number of contact events (tackles and rucks) at higher playing levels,²⁴ possibly with greater impact forces, which in turn may be a result of better training status³ and a greater level of competitiveness.

The most common single body site for medical attendances was the head, accounting for 24% of all attendances and approximately 1 attendance for a head injury for each team per match. Although no other studies of community

TABLE 3
Top 10 Injuries for Medical Attendances (All Playing Groups Combined)

Rank	Site	Injury	Attendances per 1000 Player-Match Hours (95% CI)	% of All Attendances	% of Injuries Removed
1	Head	Laceration	22 (21-22)	9	11
2	Head	Contusion	16 (15-17)	7	8
3	Ankle	Ligament/joint	13 (12-14)	6	29
4	Knee	Ligament/joint	13 (12-14)	6	35
5	Shoulder	Ligament/joint	9 (9-10)	4	32
6	Thigh	Contusion	9 (8-9)	4	14
7	Thigh	Muscle strain	8 (8-9)	4	41
8	Head	Neural	7 (6-7)	3	42
9	Lower leg	Contusion	6 (5-6)	3	16
10	Knee	Contusion	5 (5-6)	2	14

TABLE 4
Medical Attendances by Body Region for Positional Groups

Position	Attendances per 1000 Player-Match Hours (95% CI)				
	All Regions	Head/Neck	Upper Limb	Trunk	Lower Limb
Forwards	254 (245-259) ^a	79 (76-82) ^a	57 (55-60) ^a	28 (27-30) ^a	89 (86-93) ^a
Backs	191 (187-196)	50 (48-53)	38 (36-40)	21 (20-23)	82 (79-85)
Front row	264 (256-273) ^{b,d,e}	86 (81-91) ^{b,d,e}	59 (55-63) ^{b,d,e}	32 (29-35) ^{b,d,f}	88 (84-93) ^{b,e}
Second row	218 (208-227)	64 (59-70)	48 (44-53)	25 (22-29)	80 (74-86)
Back row	268 (259-277) ^{b,d,e}	83 (78-88) ^{b,d,e}	62 (58-66) ^{b,d,e}	27 (24-29) ^d	97 (92-102) ^c
Scrum half	212 (199-225) ^b	61 (55-69)	47 (41-53)	28 (23-33) ^d	76 (68-84)
Inside backs	200 (192-207) ^b	54 (51-58) ^b	39 (36-43) ^b	22 (20-25)	84 (79-89)
Outside backs	176 (169-183) ^c	43 (40-47) ^c	34 (31-37) ^c	18 (16-20) ^c	81 (77-87)

^aSignificantly different versus backs ($P < .01$).

^bSignificantly different versus second row ($P < .05$).

^cSignificantly different versus all positional groups ($P < .05$).

^dSignificantly different versus inside and outside backs ($P < .05$).

^eSignificantly different versus scrum halves ($P < .05$).

^fSignificantly different versus back row ($P < .05$).

rugby have reported medical attendances independently to time-loss injuries, this finding is in agreement with another study that combined information for both medical attention and time-loss injuries and reported that 27% of all injuries were sustained to the head and face, the majority of which were slight (0-1 days' absence).²⁶ Furthermore, using a similar injury definition as the current study, Hollis et al¹¹ reported an incidence of 8 mild traumatic brain injuries per 1000 player game hours, which is comparable to the 7 injuries per 1000 player hours for neural head injuries in the current study. A previous investigation into time-loss injuries in English men's community rugby²³ showed an incidence of 1.2 concussions per 1000 player-match hours. Although concussion diagnoses were not specifically reported in the current study, this would appear to represent a reasonable difference between those head injuries that require medical attention and those that result in 8 days or greater time loss.

It is noteworthy that there was a combined incidence of 23 per 1000 player hours for injuries diagnosed as head contusion (16 per 1000 player hours) or nerve/neural injuries and that many of the attendances in the current study were for lacerations, the outward signs of which on some occasions

could potentially mask the more serious symptoms related to concussion. These findings demonstrate that there are a larger number of injuries whereby the player has received some trauma to the head, thus highlighting the importance of pitch-side injury management staff being able to recognize potentially serious head injuries. This underpins recent concussion education resources (eg, World Rugby "Recognize and Remove," RFU "Headcase") that place an emphasis on pitch-side staff to recognize potentially serious injuries and remove the player from the pitch.

Knee and ankle joint/ligament injuries accounted for 11% of all medical attendances, with 35% (knee) and 29% (ankle) of all these attendances resulting in the player being removed permanently from play, compared with the overall removal rate for all injuries of 20%. Although these sites incur fewer attendances than the head, the greater likelihood of the player leaving the pitch suggests that these injuries could have a greater disruption to the team's performance. Although no other studies present the severity of the injury in terms of whether the player was removed from play, the current results are in agreement with previous reports that injuries to the knee are often the most severe for time loss.^{14,23} When specific body sites were

collated as body regions, the lower limb region accounted for the most attendances, which is consistent with the findings from the majority of the rugby injury epidemiology literature regardless of the injury severity.^{2,7,14,16,23}

Overall, there were more medical attendances for forwards compared with the backs for all body regions, with the greatest differences in frequency of attendances for the head/neck and upper limb regions. These results may reflect the requirements of each positional group, with front and back row forwards in particular traditionally being involved in ball carrying and contesting possession during contact events while backs have less involvement in contact.²⁵ A previous study of elite match play showed that back row forwards contested 87 bouts of scrums, rucks, mauls, and tackles compared with 18 by outside backs.²⁵ Although it was beyond the scope of this study to determine the event leading to the medical attendance, the majority of match injuries are sustained in contact events,²³ and therefore it is likely that the higher attendance incidence for forwards is the result of a greater exposure to contact events. The greater incidence for thigh muscle strains (encompassing quadriceps and hamstring strains) for backs compared with the forwards may reflect a greater running demand during match play for backs.^{21,25}

The higher injury incidence in the second half of the match follows the same pattern as other studies that report on both medical attention and time-loss injuries.^{1,14,26} This could be attributable to fatigue later in the match, which may compromise the activation of the lower limb muscles in stabilizing the joint in response to destabilizing events,¹⁰ but a relationship between fatigue and injury incidence in rugby has not yet been established. Another explanation could be that there is a cumulative effect of an injury, whereby the player may get injured early on but does not seek medical assistance until later in the match. There was a greater chance that the player was removed from play when attended to later in the match, which may be due to coaches being more likely to substitute a player later in the match for an injury that the player might not have been removed for earlier on.

CONCLUSION

This study has for the first time provided information on the nature of injuries requiring medical attendance during English community senior-level rugby union match play. This information can inform pitch-side injury management staff of the types of injuries they can expect to attend to during community rugby union match play. It is likely that there will be an injury for each team per match severe enough for the player to leave the pitch and at least 1 attendance for each team per match for a head injury. These findings highlight the prerequisite requirement for pitch-side staff to be able to recognize potentially serious injuries.

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REFERENCES

1. Bathgate A, Best JP, Craig G, Jamieson M. A prospective study of injuries to elite Australian rugby union players. *Br J Sports Med.* 2002;36:265-269.
2. Best JP, McIntosh AS, Savage TN. Rugby World Cup 2003 injury surveillance project. *Br J Sports Med.* 2005;39:812-817.
3. Bird YN, Waller AE, Marshall SW. The New Zealand rugby injury and performance project: V. Epidemiology of a season of rugby. *Br J Sports Med.* 1998;32:319-325.
4. Brooks JHM, Fuller CW, Kemp SPT, Reddin DB. A prospective study of injuries and training amongst the England 2003 Rugby World Cup squad. *Br J Sports Med.* 2005;39:288-293.
5. Brooks JHM, Fuller CW, Kemp SPT, Reddin DB. Epidemiology of injuries in English professional rugby union: part 1 match injuries. *Br J Sports Med.* 2005;39:757-766.
6. Chadwick S, Semens A, Schwarz EC, Zhang D. *Economic Impact Report on Global Rugby. Part III: Strategic and Emerging Markets.* Coventry, UK: Centre for International Business of Sport, Coventry University; 2010.
7. Chalmers DJ, Samaranyaka A, Gulliver P. Risk factors for injury in rugby union football in New Zealand: a cohort study. *Br J Sports Med.* 2012;46:95-102.
8. Gissane C, Hodgson L, Jennings D. Time-loss injuries versus non-time-loss injuries in the first team rugby league football: a pooled data analysis. *Clin J Sport Med.* 2012;22:414-417.
9. Haseler C, Carmont MR, England M. The epidemiology of injuries in English youth community rugby union. *Br J Sports Med.* 2010;44:1093-1099.
10. Hassanlouei H, Arendt-Nielsen L, Kersting UG, Falla D. Effect of exercise-induced fatigue on postural control of the knee. *J Electromyogr Kinesiol.* 2012;22:342-347.
11. Hollis SJ, Stevenson MR, McIntosh AS, Shores EA, Collins MW, Taylor CB. Incidence, risk, and protective factors of mild traumatic brain injury in a cohort of Australian nonprofessional male rugby players. *Am J Sports Med.* 2009;37:2328-2333.
12. Jakoet I, Noakes TD. A high rate of injury during the 1995 Rugby World Cup. *S Afr Med J.* 1998;88:45-47.
13. Junge A, Dvorak J. Soccer injuries: a review on incidence and prevention. *Sports Med.* 2004;34:929-938.
14. Kemp SPT, Brooks KHM, Fuller CW, Anstiss T, Smith A, Taylor A. England Rugby Premiership Injury and Training audit: 2010-2011 season report. 2011. http://www.rfu.com/news/2012/january/newsarticles/~media/files/2012/rfu_injury%20and%20training%20audit%202010-11_v5.ashx. Accessed February 10, 2014.
15. Kirkwood BR, Sterne JAC. *Essential Medical Statistics.* 2nd ed. Malden, MA: Blackwell Science; 2003.
16. McIntosh AS, Duffield R. *Rugby Union Injury Surveillance Study. 2007 Summary Report.* Sydney, Australia: School of Safety Science, University of New South Wales; 2007.
17. Murtaugh K. Field hockey injuries. *Curr Sport Med Rep.* 2009;8:267-272.
18. Orchard J, Seward H. Epidemiology of injuries in the Australian Football League, seasons 1997-2000. *Br J Sports Med.* 2002;36:39-45.
19. Palmer-Green D, Stokes KA, England M, Trewartha G. Epidemiology of injuries in English youth rugby union. *Am J Sports Med.* 2013;41:749-755.
20. Quarrie KL, Alsop JC, Waller AE, Bird YN, Marshall SW, Chalmers DJ. The New Zealand rugby injury and performance project. VI. A prospective cohort study of risk factors for injury in rugby union football. *Br J Sports Med.* 2001;3:157-166.
21. Quarrie KL, Hopkins WG, Anthony MJ, Gill ND. Positional demands of international rugby union: evaluation of player actions and movements. *J Sci Med Sport.* 2013;16:353-359.
22. Rae K, Britt H, Orchard J, Finch C. Classifying sports medicine diagnoses: a comparison of the International Classification of Diseases 10-Australian Modification (ICD-10-AM) and the Orchard Sports Injury Classification System (OSICS-8). *Br J Sport Med.* 2005;39:907-911.

23. Roberts SP, Trewartha G, England M, Shaddick G, Stokes K. Epidemiology of time-loss injuries in English community-level rugby union. *BMJ Open*. 2013;3:e003998.
24. Roberts SP, Trewartha G, England M, Stokes K. Propensity of contact events to cause injury in community rugby union: a focus on collapsed scrums and collision tackles [published online February 10, 2014]. *Br J Sport Med*. doi:10.1136/bjsports-2013-092988.
25. Roberts SP, Trewartha G, Higgitt RJ, El-Abd J, Stokes K. The physical demands of English elite level rugby union. *J Sports Sci*. 2008;26:825-833.
26. Schneiders AG, Takemura M, Wassinger CA. A prospective epidemiological study of injuries to New Zealand premier club rugby union players. *Phys Ther Sport*. 2009;10:85-90.
27. Targett SG. Injuries in professional rugby union. *Clin J Sport Med*. 1998;8:280-285.