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Original article

English professional football players concussion knowledge and attitude

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Abstract

Background: Concussions are a common pathology in football and multiple misconceptions exist amongst the players and managers. To address these misconceptions, and potentially reduce concussion associated sequela, effective educational interventions need to be developed. However, the current knowledge and attitude status must be ascertained to appropriately develop these interventions. The purpose of this study was to assess the concussion knowledge and attitude of English professional footballers.

Methods: Twenty-six participants from one English Football League Championship club completed the study. A mixed methods approach included the Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS) and a semi-structured interview. The RoCKAS contains separate knowledge (0–25) and attitude (15–75) scores and was followed by a semi-structured interview consisting of concussion knowledge, attitude, and behavior related questions.

Results: The mean score on the RoCKAS knowledge was 16.4 ± 2.9 (range 11–22) and the attitude score was 59.6 ± 8.5 (range 41–71). The interview responses identified inconsistencies between the RoCKAS and the intended behaviors, endorsing multiple concussion misconceptions, and revealed barriers to concussion reporting.

Conclusion: The results of this study suggest that Championship Level English footballers have moderate concussion knowledge, safe attitudes, and good concussion symptom recognition when assessed with pen and paper questionnaires. However, within the semi-structured interview many respondents reported unsafe concussion behaviors despite accurately identifying the potential risks. Further, multiple barriers to concussion reporting were identified which included perceived severity of the injury, game situations, and the substitution rule. These findings can help form the foundation of educational interventions to potentially improve concussion reporting behaviors amongst professional footballers.

Keywords: Concussion; Concussion recovery; Concussion reporting; Football; Mild traumatic brain injury; RoCKAS

1. Introduction

Football, soccer in the US, is the world's most popular sport with an estimated 270 million participants worldwide with 1.5 million participants in England.[1,2] While participation in football conveys many positive aspects, the risk of concussion is substantial with almost a quarter of all injuries being concussions and a 50% 10-year concussion risk amongst male elite players.[3,4] Recent high profile football concussion cases (e.g., Hugo Lloris, Taylor Twellman, and Jeff Astle) and the controversies at the 2014 World Cup have served to heighten the awareness in the football community.[5] Thus, the International Federation of Association Football (FIFA) has endorsed the 4th International Consensus Statement on Concussion in Sport (4th CIS) to improve concussion care amongst footballers.[6] Unfortunately, English Championship League teams are largely non-compliant with the CIS guidelines with limited preseason testing, lack of utilization of objective evaluation methods, and limited fixed rest periods.[7]

Appropriate and timely concussion management is critical to reduce both the immediate and long-term effects of concussions. A multifaceted concussion assessment program, with

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comparison to premorbid data, is highly sensitive in acute concussion diagnosis, once a concussion is suspected.[8,9] However, most concussions do not present with loss of consciousness or obvious disorientation; therefore, patient self-report of symptoms is critical to appropriate concussion management.[10] Unfortunately, underreporting of suspected or potential concussions remains prevalent which may delay appropriate care.[11,12] Timely recognition is critical to prevent second impact syndrome which, while rare and debated, is potentially fatal.[13,14] Furthermore, once an individual has suffered a concussion they are at a 3–6 times elevated risk for repeat concussion which will likely present worse and have prolonged recovery.[15–17] Finally, multiple lifetime concussions may elevate the risk of later life neurological impairments.[18–20]

Multiple concussion-related misconceptions persist which may impede appropriate and timely care. Generally, US based studies have reported increasing concussion knowledge amongst athletes compared studies from the early 2000s.[11,21–27] Despite these reported improvements, multiple misconceptions persist including not recognizing subtle concussions symptoms, not recognizing a potential concussion, and the risk of potential complications.[11,21–25] Further, important misconceptions underlie common responses that athletes continue to participation despite experiencing concussion related symptoms.[28,29] These misconceptions appear to be similar between the US and UK and are potentially driven by inaccurate media portrayal of concussions.[28] The British general public concussion misconceptions include underestimating of the seriousness of a concussion, a lack of knowledge of the dose–response relationship or increased vulnerability to subsequent concussion, and believing the patient is the best source to identify recovery.[29] Further, there is no relationship between personal history of concussion and concussion knowledge suggesting individuals themselves are ill-equipped to recognize and self-report a potential concussion.[29]

Both research findings and popular media reporting indicated that footballers routinely continue to play despite potential concussions and are often praised for their toughness.[21,30–32] Indeed, over 60% of concussions were unreported amongst youth Italian footballers.[33] The first step in developing an appropriate education intervention is to assess the information of the current population;[34] however, the majority of concussion knowledge studies have investigated U.S. student-athletes and extrapolation to other populations/countries may be inappropriate.[21,25] Further, many of survey's utilized in these studies provide little or no psychometric properties; therefore the Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS) was designed to address these limitations.[35] The RoCKAS has undergone extensive sychometric testing, is valid and reliable instrument, and has successfully both identified continued participation despite potential concussion symptoms and the failure to report common concussion symptoms to appropriate healthcare providers.[26] Therefore, the purpose of this study was to assess the concussion knowledge and attitude of English professional footballers utilizing both a psychometrically appropriate questionnaire as well as a semi-structured interview.

2. Methods

2.1. Participants

There were 26 participants (age: 23.4 ± 4.5 years; playing experience: 16.4 ± 4.4 years; concussion history: 50%, 0.7 ± 0.8 prior concussions) from one English Football League Championship club out of 29 possible team members. The inclusion criteria for participation were being a team member (on the club's roster), over the age of 18, and speaking English as a primary language. One individual declined to participant in the study and 2 were excluded for being under the age of 18 at the time of the study. Participants were recruited with the team physiotherapist's assistance and no incentives were provided. All participants provided written informed consent prior to participating as approved by the Georgia Southern University Institutional Review Board.

2.2. Procedures

There were 2 assessments performed in this study: 1) the RoCKAS and 2) a semi-structured interview. The RoCKAS consists of 55 questions divided into 5 sections with 2 scores: a concussion knowledge index (CKI) and concussion attitude index (CAI).[35] The CKI contains 14 basic true/false questions in Section 1, 3 applied true/false questions, and recognition of 8 common concussions symptoms (with 8 non-scored distractors) for a total score range of 0–25 with a higher score representing greater concussion knowledge. The 16 potential symptoms were based on previous published symptom recognition studies as the distractors were deemed more plausible (e.g., abnormal sense of smell/taste, black eye, and neck pain) than the original RoCKAS distractors (e.g., hair loss, excessive studying, and arthritis) and is reliable.[36,37] The CAI contains 15 Likert scale (1–5) questions and participants received 1–5 point per questions with the safer answer receiving 5 points and the least safe answer receiving 1 point for a potential score range of 15–75. The RoCKAS has undergone extensive psychometric testing and is valid and reliable.[35] An internal validity index consisted of 3 true/false questions in Section 1 and a score of <2 resulted in the test being considered invalid.

The semi-structured interview consisted of 27 primary questions and 10 follow-up questions based on current concussion literature. To ensure face validity and potential language issues of both assessments, the questions were 1) reviewed by experts within the field, 2) reviewed by 2 physiotherapists in the UK, and 3) pilot tested on several professional English football players (Appendix 1). To conduct the study, the lead author traveled to England and performed the investigation during the 2012 pre-season training camp. The potential participants reported not receiving formal concussion education prior to their enrollment in this study. After receiving written informed consent from the participants, the RoCKAS instrument was completed individually and privately. The semi-structured interview was performed last and conducted in a private setting without any teammates, coaches, or the physiotherapist present.[6,28,30,33] The players were asked the questions

and instructed to expand as much as possible. Follow-up questions were utilized to both find deeper meaning as well as clarify responses from participants. Specifically, this approach allowed the research team the opportunity to acquire more details from the respondent to allow them to fully explain their answers and/or describe relevant examples or scenarios. Upon analysis and transcription, pseudonyms were assigned to further protect participant's privacy. The entire process lasted less than approximately 20 min per participant.

2.3. Data analysis

This was a mixed methodology cross sectional study design. The CKI (0–25) and CAI (15–75) scores were derived from the questionnaire and descriptive statistics were calculated. The interview recordings were transcribed by the lead author, returned to the participants to confirm accuracy, and then had irrelevant and repetitive data (e.g., umm) removed. The participant's responses during the semi-structured interview were categorized and compared to their survey answers. The RoCKAS data were recorded and calculated with Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA).

3. Results

3.1. RoCKAS survey

All participants completed the questionnaire, passed the validity index (2.6 ± 0.5, range 2–3), and were therefore included in the results; however, 1 participant did not complete the symptom component of the RoCKAS. The CKI component score was 16.4 ± 2.9 (range 11–22) (Table 1). Within the CKI, the most common knowledge questions correctly identified were: 1) players will not become "less intelligent" after sustaining concussions (100%, 26/26: S1 Question 12), 2) loss of consciousness being required for a concussion (88.5%, 23/26: S1 Question 5), and 3) recognition that concussions will affect sport performance (88.5%, 23/26: S2 Question 3). Three substantial misconceptions were identified: 1) there was no increased likelihood of repeat concussion after a player had sustained one (3.8%, 1/26: S1 Question 3), 2) brain imaging could detect physical damage from concussions (26.9%, 7/26: S1 Question 11), and 3) there were no long-term risks to health from multiple concussions (46.2%, 12/26: S1 Question 18).

The CAI component mean score was 59.6 ± 8.5 (range 41–71) (Table 2). The safest attitudes were about athletes who were knocked unconscious being taken to the emergency room (80.8%, 21/26: S3 Question 7), managers keeping players with concussions out of games (80.8%, 21/26: S4 Question 1), and physiotherapists making return to play decisions regarding concussions (69.3%, 18/26: S4 Question 8). The riskiest behaviors included return to play with a concussion during semifinal playoff games (38.5%, 10/26), and playing through a headache resulting from a concussion (57.7%, 15/26).

The mean symptom recognition score, out of 16 symptoms, was 13.3 ± 1.6 (range 11–16). The correct symptom score alone, a component of the CKI, was 6.2 ± 1.5 (range 4–8) (Table 3). The most commonly identified symptoms were headache (100%; 25/25), dizziness (92%; 23/25), blurry vision (92%; 23/25), confusion (92%; 23/25), and loss of consciousness (LOC) (80%; 20/25). The most commonly missed correct symptoms were amnesia (52%; 13/25) and sleep problems (48%; 12/25). Amongst the distractions, participants identified decreased neck range of motion as a concussion symptom

Table 1
Concussion knowledge index (CKI).

Question	True (%)	False (%)
Section 1		
1. There is a possible risk of death if a second concussion occurs before the first one has healed.	**69.2 (18)**	**30.8**
3. People who had one concussion are more likely to have another concussion.	**3.8 (1)**	96.2
5. In order to be diagnosed with a concussion, you have to be knocked out.	11.5	**88.5 (23)**
6. A concussion can only occur if there is a direct hit to the head.	69.2	**30.8 (8)**
7. Being knocked unconscious always causes permanent damage to the brain.	3.8	**96.2 (25)**
8. Symptoms of a concussion can last several weeks.	**88.5 (23)**	11.5
9. Sometimes a second concussion can help a person remember things that were forgotten after the first.	26.9	**73.1 (19)**
11. After a concussion occurs, brain imaging (CAT scan, MRI, X-ray, *etc.*) typically show visible physical damage (bruise, blood clot) to the brain.	73.1	**26.9 (7)**
12. If you receive one concussion and you have never had a concussion before, you will become less intelligent.	0	**100 (26)**
13. After 10 days, symptoms of a concussion are usually completely gone.	**53.8 (14)**	46.2
14. After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	46.2	**53.8 (14)**
16. Concussions can sometimes lead to emotional disruptions.	**53.8 (14)**	46.2
17. An athlete who gets knocked out after getting a concussion is experiencing a coma.	**7.7 (2)**	92.3
18. There is rarely a risk to long-term health and well-being for multiple concussions.	53.8	**46.2 (12)**
Section 2		
1. It is likely that Player Q's concussion will affect his long-term health and well-being.	26.9	**73.1 (19)**
2. It is likely that Player X's concussion will affect his long-term health and well-being.	**61.5 (16)**	38.5
3. Even though Player F is still experiencing the effects of the concussion, his performance will be the same as it would be had he not suffered a concussion.	11.5	**88.5 (23)**

Notes: The 17 scored knowledge questions from the Rosenbaum Concussion Knowledge and Attitudes Survey instrument. The correct answer is bolded and the number of respondents (of 26) is provided in parenthesis. The total CKI score is calculated by adding the number of correct answers from these 17 questions along with the number of correctly identified actual concussion symptoms (Table 3).
Abbreviations: CAT = computerized axial tomography; MRI = magnetic resonance imaging.

Table 2
Concussion attitude index (CAI).

Question	SD	D	N	A	SA
Section 3					
1. I would continue playing a sport while also having a headache that results from a concussion.	**15.4**	**26.9**	3.8	42.3	11.5
2. I feel that managers need to be extremely cautious when determining whether an athlete should return to play.	0	0	19.2	**42.3**	**38.5**
5. I feel that concussions are less important than other injuries.	**34.6**	**42.3**	23.1	0	0
6. I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	**26.9**	**42.3**	19.2	7.7	3.8
7. I feel that an athlete who is knocked unconscious should be taken to the emergency room.	0	3.8	15.4	**50.0**	**30.8**
Section 4					
1. I feel that Manager A made the right decision to keep Player R out of the game.	3.8	7.7	7.7	**46.2**	**34.6**
2. Most athletes would feel that Manager A made the right decision to keep Player R out of the game.	3.8	11.5	7.7	**46.2**	**30.8**
3. I feel that Athlete M should have returned to play during the first game of the season.	**38.5**	**42.3**	15.4	3.8	0
4. Most athletes would feel that Athlete M should have returned to play during the first game of the season.	**34.6**	**42.3**	19.2	3.8	0
5. I feel that Athlete O should have returned to play during the semifinal playoff game.	**30.8**	**42.3**	19.2	7.7	0
6. Most athletes feel that Athlete O should have returned to play during the semifinal playoff game.	**34.6**	**26.9**	26.9	11.5	0
7. I feel that the physiotherapist rather than Athlete R should make the decision about Athlete R returning to play.	3.8	11.5	19.2	**30.8**	**34.6**
8. Most athletes would feel that the physiotherapist rather than Athlete R should make the decision about returning Athlete R to play.	0	11.5	15.4	**38.5**	**30.8**
9. I feel that Athlete H should tell the manager about the symptom.	0	3.9	15.4	**46.2**	**34.6**
10. Most athletes would feel that Athlete H should tell the manager about the symptoms.	0	0	23.1	**38.5**	**38.5**

Notes: The 15 Likert scale (1–5) questions from the Rosenbaum Concussion Knowledge and Attitudes Survey instrument. The safer attitude is bolded. There was a total of 26 respondents to question and the percentages (%) provided are based on these 26 responses. Each participant receives 1–5 points depending on their answer with 5 points representing the safest answer and 1 point representing the least safe answer.
Abbreviations: SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree.

(44%; 11/25) and no other distractor was selected by more than 16% of respondents.

3.2. Semi-structured interview

One participant did not perform a semi-structured interview due to time constraints leaving 25 respondents. Concussion knowledge was most commonly attributed to general knowledge (36%, 9/25) or personal/teammate concussion experience (32%, 8/25); however 20% (5/25) indicated no concussion knowledge. The majority of respondents (64%, 16/25) defined a concussion as a head blow with some variation of common concussion symptoms; however several misconceptions were endorsed including the requirement to lose consciousness (12%, 3/25); brain bleeding (4%, 1/25); or having no knowledge of a concussion (20%, 5/25).

Almost all respondents (96%, 24/25) indicated there were risks associated with playing with a concussion with most suggesting later life risk of "serious stuff" or "cognitive problems". However, many respondents (64%, 16/25) indicated they would continue to participate if they believed they had suffered a concussion. In seeming contradiction, most respondents (80%, 20/25) indicated a player with a concussion should immediately be removed from participation and most (96%, 24/25) would report the suspected injury to the medical staff. However, only 9 respondents (36%) indicated it was the medical staff alone that should decide when a player is removed while others suggested the responsibility was the players alone (24%, 6/25), the medical staff and player decide together (24%, 6/25), the medical staff, player, and manager (12%, 3/25), and 1 respondent indicated it was solely the manager's decision (4%). There was no consensus for how long a player should be withheld from participation with answers ranging from a day to month; however, none of the respondents indicated any clinical based recovery timeline (e.g., symptom free plus a week of progressive exercise). Following a concussion, the majority of respondents indicated the medical staff (60%, 15/25) is responsible for determining return to play status. However, the remaining respondents indicated the responsibility was either the player alone (20%, 5/25) or the player and medical staff (20%, 5/25) — usually indicating the player feeling ready to play after receiving medical clearance.

Table 3
The 16-item symptom recognition checklist.

Symptom	Current study	Saunders et al.[37] 2013 (n = 150)	Valovich-McLeod et al.[36] 2007 (n = 156)
Abnormal sense of smell	96.0	74.7	5.8
Abnormal sense of taste	100.0	75.3	7.1
Amnesia	**52.0**	**64.7**	**60.3**
Blurred vision	**92.0**	**93.3**	**53.8**
Black eye	88.0	90.0	79.5
Chest pain	100.0	91.3	88.5
Confusion	**92.0**	**94.0**	**89.1**
Dizziness	**92.0**	**94.7**	**88.5**
Headache	**100.0**	**96.7**	**77.6**
Loss of consciousness	**80.0**	**90.7**	**80.1**
Nausea	**64.0**	**71.3**	**55.8**
Nosebleed	84.0	70.7	95.5
Numbness/tingling in the upper extremity	92.0	49.3	82.7
Sharp burning pain in the neck	96.0	64.0	89.7
Sleep disturbances	**48.0**	**55.3**	**12.8**
Weakness of neck range of motion	56.0	57.3	10.9

Notes: The percentage (%) of respondents who correctly identified each symptom and actual concussion symptoms are bolded. The respondents in this study had similar results to previous studies which utilized the identical symptom checklist.

The respondents clearly indicated that the circumstances of the suspected concussion would influence their actions. The majority of respondents indicated the importance of the match (96%, 24/25) and the availability of substitutions (64%, 16/25) would influence reporting likelihood. Further, when presented with a scenario in which all 3 substitutions were already utilized, thus reducing their team to only 10 players, all but 4 respondents indicated this would influence their reporting decisions. A minority of respondents (32%, 8/25) indicated they would not report a teammate's suspected concussion to the medical staff and several (12%, 3/25) indicated it would depend on the circumstances.

4. Discussion

Underreporting of concussions remains a substantial problem in sports medicine and understanding the athlete's concussion knowledge and attitudes may provide a foundation to develop appropriate educational interventions.[11,21,33,34] The primary finding of this study was adequate concussion knowledge and attitude when assessed with a pen and paper questionnaire; however, the semi-structured interview revealed numerous misconceptions, potentially dangerous behaviors, and clear contradictions between questionnaire and interview. These results, in agreement with other recent findings, suggest that concussion knowledge amongst athletes may not be the primary problem; rather, the athletes may be well aware of the concussion risks but still choose to ignore these risks or do not connect their personal actions with the risks.[11,25,38,39] These results do provide several areas where traditional knowledge based educational interventions could be effective in modifying athlete actions.

Despite strong psychometric properties, the RoCKAS questionnaire has received limited utilization in the literature.[26,35] The participants herein scored lower on the CKI (16.4 ± 2.9) than National Collegiate Athletic Association (NCAA) hockey players (range 20–21), but had similar CAI scores (59.6 *vs.* 57–64).[26] Several concerning CKI misconceptions were prevalent including 1) a lack of awareness of the dose–response (increased vulnerability from previous concussion) relationship (96.2%), 2) the belief that imaging studies can identify concussions (73.1%), 3) a concussion requires a direct hit to the head (69.2%), and 4) there are no long-term health issues associated with multiple concussions (53.8%). These misconceptions were similar to both U.S. athletes and the English general public.[12,29] Within the interview, several comments endorsing these misconceptions included that "brain scans" are required to identify concussion diagnosis and severity, that concussions involve "bleeding on the brain" or "hemorrhages", and the player had to be "knocked out" to have suffered a concussion. Interestingly, the respondent who indicated a concussion involved a brain bleed also suggested it was a less serious injury than a "leg break", but endorsed the concussed player immediately being removed from participation. Specific to symptom recognition, the respondents correctly identified most symptoms (6.2/8) with 4 symptoms exceeding 88% recognition. The most commonly missed concussion symptoms were sleeping problems (52%), amnesia (52%), and nausea (36%) which is consistent with previous findings.[24,33,36,37,40] These results suggest that while there are persistent misconceptions, most professional footballers have moderate concussion knowledge and recognize most common concussion symptoms.

The respondents indicated conservative concussion attitudes on the RoCKAS questionnaire by providing the safer response on 14 of the 15 attitude questions. Continuing to participate with a concussion related headache (53.8%) was the only scenario, on average, in which an unsafe attitude was endorsed. Overall, most respondents indicated that players do not have a responsibility to play through a concussion (69.2%), the physiotherapist should be responsible for deciding playing status (65.4%), footballers should inform their manager of suspected concussion even if it means being removed from play (80.8%), respondents supported a manager who removed a player suspected of suffering a concussion (77.8%), and this attitude persisted even when a hypothetical playoff game was presented (73.1%). Conversely, the interview revealed only 28% (7/25) indicating they would not attempt to play through a concussion with comments including, "I'd try to. If I couldn't then I'd stop, but I'd try to", "I've played through a concussion . . . if your vision is fine, man up and do it", and "If I felt like I could then yeah" despite each of these specific individuals indicated they would not play through a concussion on the RoCKAS. These responses stand in direct contrast to the FIFA endorsed 4th CIS which indicated immediate removal from play for anyone suspected of suffering a concussion.[6] This is not surprising as no respondents indicated awareness or knowledge of the FIFA concussion policy; however, several respondents did request additional information on the FIFA policy and concussions overall at the conclusion of the interview.

The severity of a concussion was inconsistently described by the respondents. Some players downplayed the condition, "If I got a concussion, I wouldn't take it as seriously as a groin strain or hamstring", "not like a broken leg", "not as serious as leg injuries because you're using them more at the time in football", whereas others appeared to take the injury very seriously, "it's your brain and it's pretty important to everyday life so it needs to be taken care of". However, this respondent then followed immediately with a description of when he tried to play through a concussion and admitted he would try again, "yeah, I'd try . . . if I just felt minor symptoms then I'd carry on". Interestingly, one respondent indicated, "I'd play through it" and in the same answer stated "if it was bad I'd come off . . . because your life is at risk as well". Similar to Irish rugby players, most respondents indicated there were short- and long-term risks associated with playing through a concussion; however, most were unable to clarify those risks beyond "more damage" or "cognitive problems".[41] Potentially, this could be an area of focus for educational interventions to help players connect their short-term decisions with potential risks of later life neuropathologies.[18–20,42,43]

Two external factors which influenced concussions reporting likelihood was the substitution rule and the match importance.[44] Almost all respondents (24/25) indicated

match importance influenced their decision on concussion reporting during the interviews compared to 73.1% on the RoCKAS indicating a playoff game would not change their attitudes. These results support a recent finding in U.S. high school student-athletes that reporting intention may not be reflective of actual reporting behaviors.[25] When presented with a scenario wherein the club was out of substitutions and would therefore be relegated to only 10 players on the field, most respondents indicated they would continue to play and have observed others playing with suspected concussions, rather than have their team at a competitive disadvantage. Indeed, 1 respondent when presented with this scenario responded, "no, no, no" and another clearly indicating the number of substitutions would influence his decision on concussion reporting, "Depending on how many subs left. If there's subs left, you'd probably tell them." During football, unlike many sports, play may continue during an evaluation which places a substantial stress on the healthcare provider to perform a quick evaluation and/or remove a player from participation. Recently, the Australian Football League modified its substitution (interchange) rule which requires a player with a suspected concussion to be removed for at least 20 min, consisting of 10 min of rest followed by minimum 10 min concussion evaluation, during which time a substitute can participate.[45] If the players pass the SCAT-3 concussion test they are allowed to return to the game, but if fail they are removed for the remainder of the game.[45] Although open to exploitation, FIFA could consider similar modifications to football substitution rules to reduce a concussion reporting barrier.[46] FIFA, in September 2014, has proposed a 3-min break for an on-field assessment, but this duration is likely too brief for a thorough evaluation utilizing the SCAT-3 protocol.[6] Further, increased penalties (e.g., red cards, suspensions, monetary fines in professional leagues) have been suggested for intentionally causing head trauma.[47] Recently, American football has increased penalties, including mandatory suspensions, for intentional targeting of the head resulting in anecdotal reductions in intentional head impacts.[48]

Most concussions do not involve loss of consciousness or obvious impairments leaving sports-medicine clinicians to rely upon patient self-reported symptoms.[10,17,49] The culture of competitive athletics encourages individuals to continue participation despite injury and to return quickly post-injury.[50,51] Encouragingly, and consistent with a recent rugby study, most respondents indicated that the medical staff should decide when to remove a player suspected of suffering a concussion and the individual should be removed immediately.[41] However, a minority of respondents suggested the player should ultimately be personally responsible for their playing status; "If the players had concussion but he's still playing perfectly fine . . . then I don't see why there's no reason for him (not) to stay on" and "if the player can focus and come round I think the player should make the decision. End of the day it's his decision it's his career." Several respondents suggested the manager also had a role in the decision, "the physio has a choice but the manager does as well", or "I think it's more whether the manager decides to take you off or not." These responses present an obvious potential conflict whereby the medical staff can be overruled by either the player or the manager and potentially concussed individuals could continue participating. Indeed, this scenario played out during the 2014 World Cup in which a player from Uruguay continued participating despite a probable concussion and against the apparent advice of the medical staff.

Educational interventions require an accurate assessment of current population specific knowledge gaps to develop and evaluate educational strategies.[34] The goal of educational interventions is likely 2-fold; to improve the individuals concussion knowledge and, more importantly, to change the individual's behavior by encouraging reporting of self-suspected concussions.[26] U.S. high school soccer players who had received formal concussion education were more likely to report concussion-related symptoms; however, others have suggested the role of the coach and the overall athletic environment were strong predictors of reporting.[38,52] Encouragingly, multiple respondents indicated the desire for more concussion knowledge during the interview. The knowledge gaps and misconceptions identified herein may help form the foundation of knowledge transfer educational interventions.[34] It is important to note that discrepancies between pen and paper questionnaires and interviews have been previously noted, particularly in the physical activity and nutrition literature, and suggests that both methods should be utilized when assessing concussion knowledge and attitudes.[53–57] However, herein and similar to the nutrition and physical activity studies, "better" (e.g., more conservative concussion attitude) answers are typically identified on the questionnaire and "worse" (e.g., playing through a suspected concussion) answers were provided during the interview.

These findings are specific to one Championship Level English football club and may not be representative of footballers on other teams or leagues. However, studies of small groups of highly specific teams and players are not uncommon as large scale cooperation from professional leagues is difficult to secure.[40,58] Furthermore, it is assumed that respondents were honest in their responses without a societal response bias in which the respondents answered the more socially acceptable/correct answer which may not reflect their actual behavior (i.e., what I should do as opposed to what I actually do). Further, as the sample size herein was small, additional analysis relating concussion history to responses was not performed but may be an interesting area for future study. The investigator who conducted the interviews is a native U.S. English speaker and the questions were piloted and revised based on native British English speaker's feedback. However, it is possible that either the respondents or the researchers may have misunderstood cultural and sport-specific "slang" during the interview.

English footballers, based on a quantitative questionnaire, have moderate knowledge, good symptom recognition, and endorse safe concussion attitudes which, consistent with several recent studies, suggest that the recent medical and media attention to concussions may be positively influencing athletes' concussion knowledge and their aware-

ness of the appropriate concussion behaviors. However, the interview revealed concerning misconceptions and potentially harmful practices suggesting a questionnaire may not be an effective assessment tool for concussion attitudes. Further, many respondents in this study indicated a desire for more concussion knowledge through formal educational settings. Several respondents indicated the interview herein was their first concussion related discussion despite FIFA's endorsement of the 4th CIS which emphases education of athletes. Finally, these results can be applied to a concussion knowledge transfer educational program aimed at improving concussion behavior amongst professional football players.

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Authors' contributions

JMW conceived of and designed the study, performed the data collection, interpreted the data, and contributed to the writing of the manuscript. JLL contributed to the study design, data analysis and interpretation, and the writing of the manuscript. JLM contributed to the design of the study, the interpretation of the data, and the writing of the manuscript. TAB contributed to the conception and design of the study, data interpretation, and drafted the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

None of the authors declare competing financial interests.

Appendix 1: Examples of questions from the semi-structured interview.

- How would you define a concussion?
- Would you play through a concussion?
- Compared to other injuries, how serious are concuss ions?
- How long should a person with a concussion be out for?
- Do you think there are any risks of playing through a concussion?
- How serious do symptoms of a concussion have to be before a player needs to be removed from practice or a match?
- If you sustain a concussion/footballer's migraine, when should you be removed from play?
- What do you think of FIFA's concussion policy?
- Does match importance play a role in your willingness to report injuries/concussions?
- Have you ever not reported an injury for fear of letting the team or teammates down?
- Considering the rules on substitutions, are you more willing to play through injury knowing your team might need you or the substitution later on?
- What do you think the manager's opinions are on concussions?
- What do you think are the fan's views of concussions?
- If you suspected a teammate of having a concussion would you report it?
- If so, who are you most likely to report a concussion to?
- What differentiates what you would report from what you would not report?
- Have you or do you know someone who has hidden a concussion from a physiotherapist or team physician in order to play?
- What do you think are the views of concussions from the physiotherapist's perspective?

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