Title: Misunderstandings of concussion within a youth rugby population

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Conclusion: Despite generally positive results, youth rugby players were found to hold a number of misconceptions regarding concussion which should be the focus for education initiatives. Considering general subgroups of players by concussion history, age, or playing position appears unlikely to enhance the design of concussion education programmes.
Misunderstandings of concussion within a youth rugby population

PHILIP E. KEARNEY\(^1\*) and JAMES SEE\(^1\)

\(^1\)Institute of Sport, University of Chichester, Chichester, United Kingdom

*Correspondence: Philip E. Kearney, Institute of Sport, University of Chichester, Chichester, PO19 6PE, United Kingdom. E-mail: p.kearney@chi.ac.uk
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Keywords: head injuries, adolescent, sports safety, return to sport, England
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1. Introduction

The recognition and management of concussion in youth sport has become a major public health concern, particularly within rugby union. Concussion has been defined as a “traumatically induced transient disturbance of brain function and involves a complex pathophysiological process”. The incidence of child and adolescent match concussion has been reported as ranging from 0.2 to 6.9 concussions per 1000 player-hours, although these figures may well be lower than the reality due to the difficulty in making a diagnosis at training sessions and fixtures where a sufficiently trained professional is not available. Additionally, an under-reporting of concussions may further deflate these figures. This under-reporting likely stems from a lack of knowledge regarding the symptoms and consequences of concussion among players, coaches, and parents, as well as poor attitudes towards reporting concussion. Developing appropriate knowledge about and attitudes towards concussion is vital, as unidentified concussive injuries, especially among young athletes, lead to an increased risk of additional and more complicated injuries to the brain, and a delayed recovery.

Consequently, understanding stakeholder knowledge and attitude has emerged as a major avenue for research on concussion. Misconceptions about concussion have been identified in various youth sport populations, primarily from a North American context. Within the sport of rugby union, research is more limited. In a New Zealand context, a survey of parents suggested very good general knowledge on the signs and symptoms of concussion, as well as appropriate attitudes towards management. However, parents showed a lack of knowledge regarding specific return to play protocols. In an Australian context, major misconceptions have been identified in coaches’ knowledge about concussion. For example, fewer than 50% of coaches recognised the increased risk of suffering a second concussion if a player returned to play before the first concussion had fully healed, while fewer than 25% of coaches were aware that recovery time for youth players is longer than that for adults. Four papers have identified similar misconceptions held by players: two from Irish samples, one from Australia and one from New Zealand. For example, within the New Zealand context 25% of
players mistakenly believed that losing consciousness was necessary for an injury to be classified as concussion\textsuperscript{15}. Together, these studies highlight both the importance of assessing the knowledge base of key stakeholders with regard to concussion management, and also that the findings from different populations (e.g., parents v players, populations from different countries) cannot be generalized.

Adequate knowledge is important for young rugby players to understand and deal appropriately with their concussion; however, knowledge alone does not always lead to appropriate behaviour\textsuperscript{10, 16, 17}. For example, within a New Zealand rugby context, nearly 30% of players believed that a player with a suspected concussion should continue to play in important games\textsuperscript{15}. Furthermore 76% of young rugby players were aware of a concussed teammate who had been pressured to continue playing\textsuperscript{15}. The above findings make clear that in addition to promoting players’ knowledge of concussion, it is vital that player education initiatives continue to emphasise positive attitudes towards concussion management.

To date, limited research has examined subgroups within youth rugby populations who might be more at risk of concussion due to poor knowledge or attitudes. If misconceptions or biased attitudes were found to exist within these subgroups, then education initiatives could be shaped accordingly. One variable which has been investigated is history of concussion, but worryingly, it appears that a history of concussion does not promote superior knowledge or behaviours relative to players without a history of concussion\textsuperscript{13, 14}. Due to the differences in game activities required by different positions\textsuperscript{18}, playing unit (i.e., forward v backline) is an obvious candidate for investigation. While no differences have been found between forwards and backline players in the length of time that players sit out following a concussion\textsuperscript{14}, research has yet to directly investigate the knowledge and attitudes held by individuals from each playing unit. A third variable which might influence knowledge of, and attitudes towards concussion is player age. Across a range of sports, older athletes were associated with superior knowledge of concussion, while younger athletes were associated with better self-reported behaviours\textsuperscript{10}. However, the influence of age on knowledge and attitudes relating to concussion has not been investigated within a rugby union population. Finally, the Developmental Model of Sport Participation emphasises the importance of players being exposed to a broad range of social contexts for optimal development\textsuperscript{19}. With regard to concussion education, it might be
hypothesised that players who participate in multiple contexts (e.g., school and club) would show superior knowledge of, and attitudes towards concussion relative to players who participate in a single context. In summary, the objective of the current study was to establish the extent to which concussion history, playing position, age and number of playing venues influenced knowledge of and attitudes towards concussion in a sample of youth rugby players.

2. Method

With institutional ethical approval (Application 1516_21), coaches and secondary school teachers from three state schools and three rugby clubs in the counties of Hertfordshire and Sussex in the south of England were contacted via email for participation in the study. Once approval from the administrators and teachers/coaches at the school or club had been granted, informed consent was sought from the rugby players and their parents. Subsequently, players who returned completed consent forms were asked to complete the survey independently. To encourage honest responses, the submitted surveys did not include any identifying information. Data collection was carried out in January and February of 2016.

The survey instrument drew upon surveys used in previous research on concussion in youth populations. Questions were modified to ensure that they would be suitable for the target audience. To ensure that the survey was phrased appropriately, in addition to the research team, the draft survey was completed and reviewed by an under 15s rugby coach, a secondary school teacher who was also a rugby coach, a parent of a rugby playing child aged 13 and four rugby playing children aged between 11 and 17 years. Furthermore, to ensure that the survey was appropriate to newcomers to rugby, four non-rugby playing children aged 11-17 years also completed the survey.

The final survey initially requested demographic information. This demographic information included whether a concussion had been experienced, and if so, in which phase of play the concussion occurred, and how long before the participant returned to play. Subsequent questions addressed participants’ knowledge of the causes, symptoms, consequences, and treatment of concussion, as well as participants’ attitudes towards concussion and its reporting. Questions required a True/False or
multiple choice answer. Knowledge and attitude questions are displayed in Table 2, and a copy of the survey is available from the authors on request.

To address the possibility that survey responders would answer questions in a manner that would be viewed favourably by the researchers (i.e., social desirability bias), short form A of the Crandall Social Desirability test for children\textsuperscript{22} was also included in the survey. There is no categorical standard for determining socially desirable answers, but consistent with previous research\textsuperscript{23}, socially desirable answers were defined as those in which the participants score was greater than or equal to 1.5 standard deviations above the sample mean.

Descriptive statistics were generated through Microsoft Excel. Answers to the 10 knowledge and 11 attitude questions were scored 1/correct or 0/incorrect, to produce overall scores (medians and median absolute deviations (MAD)) for both knowledge and attitude. As these overall scores were not normally distributed, Mann Whitney U tests were used to determine whether the categories of age, playing unit, number of venues, and concussion history influenced knowledge and attitude scores. Pearson’s correlation coefficient \((r)\) provided a measure of effect size. To control the familywise error rate, the Holm-Bonferroni procedure\textsuperscript{24} was followed. The Holm-Bonferroni adjusted \(p\)-values were obtained by ordering \(p\)-values from lowest to highest. The smallest \(p\)-value was then multiplied by \(k\), where \(k\) was the number of hypotheses to be tested (in this case, eight). The resulting \(p\)-value was considered to be statistically significant if it was less than 0.05. The next smallest \(p\)-value was then multiplied by \(k-1\), and again compared to 0.05. This process was continued until a null hypothesis was not rejected.

3. Results

Two hundred and sixty-two rugby players initially completed the survey. Seven participants were identified as showing high social desirability bias. Upon further inspection, these participants were removed from the sample as they had provided the socially desirable response to all attitude questions. Consequently, the final sample consisted of 255 players, male (238) and female (17) aged 11-17 years (mean ± SD, 13.5 ± 1.33 years) with varying experience completed the surveys. As players in the Under 15-18 category play under a common set of rules, with only minor changes from
the adult game (http://www.englandrugby.com/governance/regulations/), participants were classified according to age (131 younger players <=13 years; 124 older players >=14 years), playing position (130 forwards; 125 backs), playing location (130 players who played at both school and club, and 125 who played at a single venue only), and concussion history (61 players who self-reported a prior concussion, 194 players with no history of concussion).

Sixty-one participants within the study (24%) reported a total of 77 concussions. Forward players were more at risk in general, suffering 65 of the 77 total reported concussions. Across all subgroups, the majority of concussions resulted from tackle situations (Table 1). Self-reported return to play ranged from 0 to 365 days. Three players did not report a timescale. Only seven players (11%) reported a return to play after the Rugby Football Union’s recommendation of 23 days.

The majority of participants (99%) correctly identified a concussion as an injury to the brain. The remaining three participants, all from the younger player category, misidentified concussion as a spinal cord injury. Overall, the findings reveal a number of positive messages regarding youth players’ knowledge of concussion (Table 2). For example, 91% of participants could identify that participants who have suffered one concussion were not less at risk of a second, while 82% reported that losing consciousness was not required for a player to be concussed. However, the results also highlight a number of key misunderstandings held by players. For example, 80% of players agreed with the statement that “Concussions can only occur from a hit to the head”. Only 2% of those surveyed identified correctly that rest was the appropriate treatment for concussion. The majority of participants (74%) reported that a combination of both rest and medication or physiotherapy was the appropriate treatment. The remainder of the sample (24%) identified only medication or physiotherapy as the appropriate treatment for concussion. The sample also performed poorly in terms of recognising the symptoms that a concussion was getting worse; while 94% correctly identified one symptom, only one respondent correctly identified all three listed symptoms associated with a worsening concussion.

Table 2 also reveals that the sample held largely positive attitudes towards concussion. For example, 97% of participants reported that they would tell their coach if they struck their head during a game, while only 10% of players felt that concussions were less important than other injuries.
Worryingly, however, at least 20% of participants reported inappropriate attitudes towards concussion on questions 12, 15, and 17-19. These five questions relate to feeling a responsibility to play, due to one’s own expectations, or those of teammates or parents.

Figure 1 illustrates the differences in knowledge and attitude scores across the subgroups. Individuals who played for both school and club teams reported significantly higher knowledge scores (median = 7 correct answers, MAD = 1) than individuals who played at only one venue (median = 6 correct answers, MAD = 1), $z = -6.879, r = 0.164, p < 0.001$. Forwards (median = 7 correct answers, MAD = 1) demonstrated superior knowledge to backs (median = 6 correct answers, MAD = 1), $z = -4.643, r = 0.135, p < 0.001$. There were no other significant differences in terms of knowledge of concussion. With regard to attitudes towards concussion, the only significant difference to emerge was that individuals who played for both school and club teams (median 11 correct answers, MAD = 0) reported a superior attitude compared to individuals who played at only venue (median = 8 correct answers, MAD = 2), $z = 4.156, r = 0.128, p < 0.001$.

4. Discussion

The purpose of this study was to explore the effect of subgroup membership on knowledge of, and attitudes towards concussion in a sample of young English rugby players. With 23% of the sample reporting having experienced a concussion, it appears that concussion effects a substantial proportion of the youth population. Responses to the survey were in large part positive, particularly in relation to attitudes towards concussion and its reporting. However, this study clearly highlights that a number of significant misunderstandings about concussion exist within the surveyed population as a whole. More specifically, and consistent with previous research, respondents demonstrated poor knowledge of the symptoms and treatment of concussion. There is a concern that insufficient knowledge of the diverse, and on occasion delayed, symptoms of concussion, may result in young athletes not reporting concussions. A major concern with unreported concussions is that players may return to play prematurely, placing them at risk of further and more complex injuries.

Consistent with previous research in youth rugby union, only 12% of participants reported adhering to the recommended return to play guidelines. As such, it appears that sustained emphasis is...
required to ensure that youth players are adequately informed about the symptoms and management of concussion.

Attitudes towards concussion reporting were also generally positive. However, consistent with previous research in rugby union and in other sports, a substantial minority of the sample (at least 20%) reported poor attitudes. These attitudes appear to be related to players feeling a responsibility to play, particularly in relation to important matches. In response to such findings, researchers are beginning to examine more closely the manner in which concussion education is being delivered to ensure effective knowledge translation. Given the potential for increased knowledge to encourage athletes to hide concussion symptoms, current recommendations stress the need for concussion education to be an on-going process, focused on population-specific issues, and engaging the players in the generation and dissemination of information.

The present study extended previous research by considering a number of subgroups which were hypothesised to influence the extent to which rugby players held poor knowledge or attitudes. Playing rugby in multiple venues (i.e., school and club) emerged as the most important factor in determining positive knowledge and attitudes. It is likely that this superior knowledge and attitude is due to players’ exposure to a broader range of messages and messengers across different contexts. As such, individuals who play rugby in multiple venues may be valuable partners in concussion education initiatives. Forwards were found to be more knowledgeable than backline players, which may be due to the higher incidence of concussions within forward players in the examined sample. However, this greater knowledge did not translate to more positive attitudes. Consequently, the broader message from the present findings is that education initiatives should not be directed at specific subgroups of players (i.e., playing unit, concussion history, age). Instead, it is probable that coaches, parents and administrators will be most effective if they identify any misconceptions and biases present within the specific group of players that they are dealing with, and to devise a bespoke intervention accordingly.

There were a number of limitations to the current study. Data was collected retrospectively, relying upon accurate self-report of concussion. As a result, players’ misunderstandings about the nature of concussion may have influenced the reported incidence of concussion. In future, research
relying upon self-report should also ask participants to confirm how/if their concussion was formally diagnosed. Selection bias is potentially an additional issue, as not all of the participants who were approached completed the survey, either through not returning the parental permission slips, or by opting out. While the majority of those approached did return the surveys, it is a limitation of the study that we did not accurately record the return rate. A third limitation was that participants’ experiences of concussion education were not recorded. As a result, it is impossible to infer whether the misconceptions are due to a lack of education, or ineffective methods of education. As described above, further research is required to understand how to best educate stakeholders regarding concussion. A final limitation is that the surveyed population was predominantly male. Although the available evidence suggests that the incidence, symptoms and duration of recovery from concussion may be increased in females, there is a lack of research investigating knowledge of and attitudes towards concussion within female populations. Future research should seek to address this issue.

5. Conclusions

In summary, the current study has extended previous research on concussion in rugby union by examining the experience of concussion in an English youth rugby population. Results indicate that concussion is a significant injury risk for this group. Neither age nor previous history of concussion influenced player knowledge or attitudes, but participants who played at multiple venues did report superior knowledge and attitudes relative to their peers who played at a single venue. Furthermore, although the reported knowledge and attitudes within the sample as a whole were generally good, a number of major misconceptions were identified which should be the focus for education initiatives.

6. Practical Implications

- All stakeholders within English youth rugby union need to continue to promote and evaluate knowledge of, and appropriate attitudes towards, concussion.
- Within player education programmes, particular attention should be paid to assisting players to identify both the immediate and the delayed symptoms of concussion.
• Player education programmes should also prioritise the management of concussion, and in particular, adherence to the recommended return to play guidelines.

Acknowledgements

There has been no financial assistance with this project. The authors would like to thank Iain Greenlees for his assistance on an earlier draft of this manuscript.
References


Table 1

Comparison of how concussions occurred by phase of play, age and playing position

<table>
<thead>
<tr>
<th>Phase of play</th>
<th>Overall</th>
<th>Younger Players</th>
<th>Older Players</th>
<th>Backline Players</th>
<th>Forward Players</th>
<th>Multi-Venue Players</th>
<th>Single Venue Players</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Tackle</td>
<td>35</td>
<td>45.5</td>
<td>18</td>
<td>41.9</td>
<td>17</td>
<td>50</td>
<td>7</td>
</tr>
<tr>
<td>Maul</td>
<td>17</td>
<td>22.1</td>
<td>14</td>
<td>32.6</td>
<td>3</td>
<td>8.8</td>
<td>0</td>
</tr>
<tr>
<td>Ruck</td>
<td>14</td>
<td>18.2</td>
<td>5</td>
<td>11.6</td>
<td>9</td>
<td>26.5</td>
<td>2</td>
</tr>
<tr>
<td>High Ball</td>
<td>4</td>
<td>5.2</td>
<td>3</td>
<td>7.0</td>
<td>1</td>
<td>2.9</td>
<td>2</td>
</tr>
<tr>
<td>Foul Play</td>
<td>7</td>
<td>9.1</td>
<td>3</td>
<td>7.0</td>
<td>4</td>
<td>11.8</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>43</td>
<td>34</td>
<td>65</td>
<td>12</td>
<td>65</td>
<td>45</td>
</tr>
</tbody>
</table>
Youth rugby players’ knowledge of and attitude towards concussion

<table>
<thead>
<tr>
<th>Questions and correct answers</th>
<th>Incorrect Answer</th>
<th>Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge questions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Concussion is</td>
<td>3 (1%)</td>
<td>252 (99%)</td>
</tr>
<tr>
<td>2. Concussions can only occur from a hit to the head (False)</td>
<td>204 (80%)</td>
<td>51 (20%)</td>
</tr>
<tr>
<td>3. Younger people have a higher chance of concussion (True)</td>
<td>132 (52%)</td>
<td>123 (48%)</td>
</tr>
<tr>
<td>4. People who have had one concussion are less likely to have another (False)</td>
<td>24 (9%)</td>
<td>231 (91%)</td>
</tr>
<tr>
<td>5. The brain is moved out of place during a concussion (True)</td>
<td>92 (36%)</td>
<td>163 (64%)</td>
</tr>
<tr>
<td>6. Do you need to be knocked out for a concussion (No)</td>
<td>46 (18%)</td>
<td>209 (82%)</td>
</tr>
<tr>
<td>7. Symptoms of concussion (Multiple choice)</td>
<td>126 (49%)</td>
<td>129 (51%)</td>
</tr>
<tr>
<td>8. There is a possible risk of death if a second concussion occurs before the first has healed (True)</td>
<td>82 (32%)</td>
<td>173 (68%)</td>
</tr>
<tr>
<td>9. Symptoms of concussion can last for several weeks (True)</td>
<td>74 (29%)</td>
<td>181 (71%)</td>
</tr>
<tr>
<td>10. After a concussion, your emotions (anger, sadness etc.) can change quickly and intensely (True)</td>
<td>88 (35%)</td>
<td>167 (65%)</td>
</tr>
<tr>
<td><strong>Attitude questions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I would tell my coach when I have hit my head (True)</td>
<td>6 (2%)</td>
<td>249 (98%)</td>
</tr>
<tr>
<td>12. I would continue playing despite hitting my head (False)</td>
<td>91 (36%)</td>
<td>164 (64%)</td>
</tr>
<tr>
<td>13. If I had a headache/dizziness after a hit to the head I would continue playing (False)</td>
<td>43 (17%)</td>
<td>212 (83%)</td>
</tr>
<tr>
<td>14. I feel concussions are less important than other injuries (False)</td>
<td>25 (10%)</td>
<td>230 (90%)</td>
</tr>
<tr>
<td>15. I have a responsibility to play while experiencing concussion symptoms (False)</td>
<td>77 (30%)</td>
<td>178 (70%)</td>
</tr>
<tr>
<td>16. Other players have a responsibility to play while experiencing concussion symptoms (False)</td>
<td>42 (16%)</td>
<td>213 (84%)</td>
</tr>
<tr>
<td>17. My parents would encourage me to carry on playing in a rugby match after hitting my head (False)</td>
<td>60 (24%)</td>
<td>195 (76%)</td>
</tr>
<tr>
<td>18. If it is an important game it is more important for a player with a concussion to return to play than to sit the match out (False)</td>
<td>52 (20%)</td>
<td>203 (80%)</td>
</tr>
<tr>
<td>19. My team mates would expect me to carry on playing in a match after a head injury (False)</td>
<td>57 (22%)</td>
<td>198 (78%)</td>
</tr>
<tr>
<td>20. Coach would encourage me to play the next game after a concussion (False)</td>
<td>10 (4%)</td>
<td>245 (96%)</td>
</tr>
<tr>
<td>21. My team mates always tell a coach or parent when they have had a concussion (True)</td>
<td>29 (11%)</td>
<td>226 (89%)</td>
</tr>
</tbody>
</table>
Figure 1. The effect of subpopulation membership on (a) knowledge of, and (b) attitudes towards concussion. Columns represent median scores, with error bars illustrating median absolute deviation. * indicates differences at the Holm-Bonferroni corrected level of significance.