Title

Sport-related concussion attitudes and knowledge in elite English female footballers

Authors

Andrew Shafik[1,2], Pippa Bennett[3], Craig Rosenbloom[3,4,5], Katrine Okholm Kryger[4,6] Sean Carmody[7], Jonathan Power[1]

Author affiliation

[1]Sport and Exercise Medicine, University of Leeds, Leeds, UK
[2]Millwall Football Club, London, UK
[3]The Football Association, Needwood, Burton-Upon-Trent UK
[4]Sport and Exercise Medicine, Queen Mary University of London, Sport and Exercise Medicine, London, UK
[5]Tottenham Hotspur Football Club, London, UK
[6]Faculty of Sport, Health and Applied Science, St Mary's University Twickenham, London, UK
[7]Amsterdam UMC, University of Amsterdam, Department of Orthopaedic Surgery, Amsterdam Movement Sciences, Meibergdreef 9, Amsterdam, The Netherlands

ORCID IDs

Craig Rosenbloom - https://orcid.org/0000-0001-6166-209X

Katrine Okholm Kryger - https://orcid.org/0000-0003-0924-6181

Sean Carmody - http://orcid.org/0000-0001-8683-5532

Twitter

@aaashafik @pbennett67 @CraigRDoctor @OkholmKryger @seancarmody1 @jonathanpower3

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PB, CR and JP hold or have held clinical roles at the Football Association. CR and SC have held clinical roles in Women's Super League teams.

Contributorship:

AS, PB, CR were involved in the original concept of the study. The data collection was achieved by AS and supervised by PB. The data analysis was completed by AS with supervision by JP. All tables and figures were designed by AS and KK. AS drafted the original manuscript and PB, CR, KK, SC and JP provided critical feedback and comments in refining the final submission.

Corresponding author

Andrew Shafik

Sport and Exercise Medicine, University of Leeds, Leeds, UK, Millwall Football Club, London, UK
E = andrewshafik@live.co.uk
A = Medical and Science Department, Millwall Football Club

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Abstract

Background: Sport-related concussions (SRC) are more common and more severe in women's football than men's yet the knowledge and attitudes of SRC in the women's game are not well understood. The objective of this study was to assess the SRC knowledge and attitude in elite female footballers.

Methods: An online questionnaire was sent to all registered players in the English Football Association Women's Super League (WSL) and Championship. Respondents completed an amended version of the Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS). Concussion Knowledge Index (CKI) and Concussion Attitudes Index (CAI) scores were derived for all respondents.

Results: One hundred and twenty three players completed the survey with 111 fitting the inclusion criteria. The mean CKI score was 20.5±2.3 and the mean CAI score was 63.3±6.3. A weak positive correlation was shown between the CKI and CAI ($r=0.20$; $p=0.03$). Previous concussion education had a significant impact on increased knowledge ($U=1198$; $p=0.04$). There was no significant difference in concussion attitudes and knowledge between the WSL and Championship or in those with a previous concussion history and no previous concussion ($p>0.05$).

Conclusion: Previous SRC education demonstrated an increased knowledge around concussion but a limited impact towards concussion attitudes. It is suggested that concussion education should be mandated across the professional game to enhance player welfare.

Keywords: soccer, football, women's football, head injury, female, concussion, understanding, awareness, knowledge, behaviour, attitude

Introduction

Sports-Related Concussion (SRC) is a traumatic brain injury defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces with several common features that help define its nature (McCrory et al., 2017). Broglio et al. (2010) showed a lack of understanding of concussion knowledge and attitudes in male juvenile Italian club level footballers with 62% of concussions in this group unreported. These results highlight a lack of concussion knowledge in academy level footballers and signify the importance of understanding the attitudes and knowledge of concussion in sport to improve player outcomes.

Okholm Kryger et al. (2021) highlighted the lack of comparable research from women's to men's football and set out an agenda of determining research priorities for the women's game. This finding is further reinforced with much of the SRC studies in the literature conducted in the male population. A systematic review into the epidemiology of SRC in female contact sports showed SRC rates of 2.08-4.04 per 1000 athletic exposure events in women's football (Walshe et al., 2022). Further to this, players with concussion education in elite English football was shown to be 48%, with education rates shown to be significantly lower in women's football compared to men's football (27% and 51% respectively: Rosenbloom et al., 2021). This highlights a discrepancy between the men's and women's game despite concussion education being recommended for athletes following the most recent Concussion in Sport Group Consensus Statement (Patricios et al., 2018). This is of concern given the documented risk in the literature of multiple concussions being a risk factor for cognitive impairment and mental health problems (Manley et al., 2017).

In current literature, only four studies investigate concussion knowledge, attitudes and beliefs in female footballers (Kryger et al., 2021), with none of these assessing these parameters in elite female footballers (Kurowski et al., 2014) (Kroshus et al., 2017) (Register-Mihalik et al., 2018) (Kim et al., 2020). In 384 male and 112 female university American football, association football, basketball and wrestling athletes, there was good concussion knowledge but poor attitude towards concussion. However, football players showed better concussion self-reporting behaviours compared to the other sports (Kurowski et al., 2014). When comparing sex difference in concussion-related knowledge, attitudes and reporting-behaviours among high school student-athletes, males expressed more negative outcomes of concussion self-reported behaviours compared to females (Kurowski et al., 2014; Sullivan and Molcho, 2021). Other key influences on concussion attitudes in male and female youth athletes have been found. Socio-economic status influenced by geographical location, positive parental attitudes towards concussion, association football in comparison to other sports and older age

(>12 years) were all associated with better youth athlete concussion knowledge (Register-Mihalik et al., 2018). This demonstrates the need to understand SRC knowledge and attitudes to optimise player welfare. This is particularly important to note given the risk of brain injury has been shown to be twice as likely in women's football in comparison to men's football (McGroarty et al., 2020; Robson, 2021). The higher rates of SRC in female athletes compared to male athletes is not fully understood (Mollayeva et al., 2018), however, a recent systematic review looking at SRC in female athletes suggested biomechanical and hormonal differences as possible contributing factors (McGroarty et al., 2020).

The aforementioned studies did not use the Rosenbaum Concussion Knowledge and Attitude Survey (RoCKAS). The RoCKAS was used as it is a comprehensive and psychometrically sound survey that has been shown to be a valid and reliable measure of concussion knowledge and attitudes (Rosenbaum and Arnett, 2010). The authors of the RoCKAS also validated the survey for coaches and parent's knowledge and attitude, highlighting its use across a range of groups. A study in English professional male football players utilised the RoCKAS and semi-structured interviews in 26 members of one English Football Championship second division club (Williams et al., 2016). Similar research has been conducted in various other sports using the RoCKAS (O'Connell and Molloy, 2016; Gallagher and Falvey, 2017). However, these studies only assess male athletes.

Given the overall lack of research in women's football, evident lack of research in concussion knowledge and attitudes in elite women's football and sex differences in SRC, the primary aim was to explore current knowledge and attitudes towards SRC within elite English female footballers. Secondary aims included whether there is a difference in knowledge and attitude between players in the English Football Association (FA) Women's Super League (WSL) and the FA Women's Championship, players with a history of SRC, and players with previous SRC education.

Methods

This research was approved by the Research Ethics Committee at the University of Leeds on 25th March 2021 (BIOSCI 20- 016).

The study was approved by the FA following meetings with the women's concussion working group – a group made up of experienced doctors and physiotherapists in the women's game.

Participants

The FA distributed an online version of the RoCKAS survey via email to doctors and physiotherapists of the twenty-three clubs across the English FA WSL and the Championship in the 2020/2021 season (The Football Association, 2021). The medical staff distributed the online survey to all registered first team players at their respective clubs noting a club can have a maximum of 25 registered players. Responses from each club were monitored and medical staff sent reminders to players to encourage participation. The inclusion criteria for participants were: (i) registered player in senior women's team for one of the twenty-three clubs. The exclusion criteria: (i) not fully consenting to the survey or (ii) failing the internal validity index (VI) consisting of three true/false questions in section one of the RoCKAS with a score of <2. The VI was included in the original RoCKAS to ensure participants were not responding randomly. No personal information was requested from participants and therefore no patient demographic data was recorded.

Survey design

An amended version of the RoCKAS survey (Rosenbaum and Arnett, 2010) was used to collect concussion knowledge and attitudes data from participants. The RoCKAS has undergone extensive testing and has been shown to be valid and reliable (Rosenbaum and Arnett, 2010).The RoCKAS survey contains 55 items divided into five sections with a specific scoring system. Section one contains 14 basic items with true or false questions, three further basic items for validity scale and one further item with no index. Section two contains three applied items with true or false questions. Section three contains five basic opinion items with a five point Likert scale ranked from 'Strongly Disagree' to 'Strongly Agree' and three further items with no index. Section four contains ten applied opinion items with five point Likert scale ranked from 'Strongly Disagree' to 'Strongly Agree'. The RoCKAS section five contains eight commonly reported post-concussive symptoms and eight distractor items where participants rank the signs and symptoms associated with a concussion. In this study, a previously validated but amended section five containing a 16-symptom scale was used rather than the original scale from the RoCKAS (Valovich McLeod et al., 2007). The rationale for the amendment was that these symptom recognition distractors were deemed more plausible than the original RoCKAS distractors and has been shown to improve the validity and reliability of this section of the survey. Valovich McLeod et al. (2007) demonstrated a very good level of internal validity and reliability (Cronbach alpha score = 0.83) in comparison to the acceptable level of internal validity and reliability of the RoCKAS (Cronbach alpha score= 0.71). The modification of section five has also been used in similar studies in the literature (Williams et al. 2016; Kraak et al. 2018).

Sections one, two and five constitute the Concussion Knowledge Index (CKI). There was a total of 25 questions and each question answered correctly scored one point for a total score range of 0-25. Sections three and four constitute the Concussion Attitude Index (CAI). These totaled 15 Likert scale (1-5) questions with participants receiving five points for the safest answer and one point for the least safe answer for a total score range of 15-75. When calculating percentage answered correctly for CAI, safe answers were those that scored 4 or 5 points.

To be able to achieve the stated objective, additional questions were asked prior to the RoCKAS questions in the survey. This included, 'Which division does your club play in?' with answer options 'The FA WSL' or 'Championship', Have you ever previously been diagnosed with a concussion?' with answer options 'Yes' or 'No' and 'Have you ever received formal concussion education?' with answer options 'Yes' or 'No'.

As the RoCKAS is an American survey, certain terms were changed to their UK equivalent i.e. 'athletic trainer' to 'physiotherapist' and 'coach' to 'manager' to avoid any potential confusion to the respondents.

Data Collection

The questionnaire was distributed via Online Surveys (Jisc, Bristol, England) and completed by participants from 26th March to 14th May 2021. Participants were advised they could skip questions they were uncomfortable with answering.

Data Analysis

Descriptive statistics were analysed for the CKI (0-25) and CAI (15-75) scores with SPSS Statistics (Version 27.0, (BM, Armonk, NY, USA). CKI and CAI scores were obtained comparing, the WSL and Championship, previous concussion and no previous concussion, and previous concussion education and no previous concussion education for players. To explore the distribution of the data, the Kolmogorov-Smirnov test was used as the total number of participants and number of participants in the sub-groups $\geq$50. The one exception to this where a sub-group <50 was when comparing players CKI and CAI in the previous concussion versus no previous concussion sub-groups. In this setting, the Shapiro-Wilke test was used instead to explore the distribution of data (Anon, 2021). Normal distribution was seen for CAI ($P \leq 0.05$) whilst CKI scores were not normally distributed ($P \geq 0.05$), hence CAI was assessed using an independent t-test and CKI using a Mann-Whitney U test to test the differences between the two nominal groups. The correlation between CKI and CAI was calculated using the Pearson Correlation Coefficient (Mukaka, 2012).

Results

Participant Characteristics

The survey was completed by 123 participants. Eleven participants were excluded for not fully consenting to the survey and one further participant excluded for failing the VI, leaving a total of n=111. Given the 111 player completed responses and a maximum of 25 players responses per club (totalling 575), there was an assumed response rate of 19% (111/575).

From the 111 participants, 49% were WSL and 51% were Championship players (Table 1). Nearly half the players reported previous concussion experience (43%) and 52% reported having received previous concussion education (Table 1).

**** Table 1 near here ****

Concussion Knowledge Index RoCKAS Outcomes

The players CKI component mean score was 20.5±2.3 of 25 possible. The question 'In order to be diagnosed with a concussion, you have to be knocked out' was answered correctly by 100% of participants (Table 2). However, on assessment of post-concussive symptoms in section five, only 72% and 52% of participants correctly identified 'loss of consciousness' and 'amnesia' as a post-concussive symptom respectively (Table 3). The most incorrectly answered CKI statement was 'after 10 days, symptoms of a concussion are usually completely gone' with 60% answering incorrectly (Table 2). The most incorrectly selected distractor option in section five included 'weakness of neck range of motion' and 'sharp burning pain in the neck with 69% and 39% respectively (Table 3).

**** Table 2 near here ****

**** Table 3 near here ****

Concussion Attitude Index RoCKAS Outcomes

The players CAI component mean score was 63.3±6.3 of 75 possible. The question 'I feel that coaches need to be extremely cautious when determining whether an athlete should return to play' was the most correctly answered CAI statement with 96% correct responses (Table 4). The most incorrectly answered CAI statement was 'I would continue playing a sport while also having a headache that resulted from a minor concussion' with only 57% answering correctly (Table 4).

**** Table 4 near here ****

Impact of league of competition

The league of competition had no significant impact on CKI scores (WSL median=21 (Q1:19, Q3:22); Championship median=21 (Q1:19, Q3:22); U=1501.5; P=0.82). Similarly, no significant impact of league of competition was seen for CAI scores (WSL mean=63.7±5.8; Championship mean= 62.8±6.8; t(109)=0.75, P=0.46; Figure 1).

Previous concussion history

Having a previous concussion (n=48) had no significant impact on CKI (median= 21 (Q1:19, Q3:22)) compared to those with no previous concussion (n=63; median=21 (Q1:19, Q3:22); U=1392; P=0.47). Similarly, having a previous concussion (n=48) had no significant impact on CAI (mean= 64.3±6.0) compared to those with no previous concussion (n=63; mean=62.5±6.5); t(109)=1.45, P=0.15).

Previous concussion education

Having previous concussion education (n=58) resulted in a statistically significant improvement in CKI (median=21 (Q1:20, Q3:22)) compared to those with no previous concussion education (n=53; median=21 (Q1:19, Q3:22); U=1198; P=0.04). On the contrary, having previous concussion education (n=58) had no significant impact on CAI (mean=63.0±6.4) compared to those with no previous concussion education (n=53; mean=63.6±6.3; t(109)=0.49, P=0.63).

Correlation between CKI V CAI scores

There was a weak positive but significant correlation between the players CKI and CAI scores (r=0.20; p=0.03; Figure 1).

Discussion

The objectives of this study were to evaluate the knowledge and attitudes towards concussion in elite female footballers, as well as carry out a comparison between the WSL and Championship, previous concussion history, and previous concussion education experience. Total number of participants, mean CKI, mean CAI and the correlation coefficient were compared between similar papers in the literature that utilised the RoCKAS (Table 5). A strength of this study was the total number of participants (players n=111) compared to similar papers, noting that Williams et al. (2016) was conducted in one Championship club and may not be a true representation of the whole

division. The main findings of this study when compared with the literature is elite female football players have greater knowledge and safer attitudes towards concussion compared to other sports in similar papers and education enhanced concussion knowledge but not attitudes towards concussion (Table 5). Level of league and previous concussion history has no effect on concussion knowledge and attitudes.

**** Table 5 near here ****

Overall knowledge and attitude

Only 53% answered the following statement correctly 'After a concussion occurs, brain imaging (e.g. CT Scan, MRI, X-ray etc.) typically shows visible physical damage (e.g. bruise, blood clot) to the brain' in this study and this was the least correctly answered knowledge statement in cycling with only 44.9% answering correctly (Hurst et al., 2019). This is concerning as it indicates a lack of understanding of basic concussion pathology and that it is associated with a structural brain injury rather than a functional brain injury (McCrory et al., 2017) and a potential contributor to the poor attitudes towards concussion. This indicates a need for focussing education on enhancing athlete knowledge on basic concussion pathology.

Comparing knowledge and attitude

The correlation coefficient (r=0.20) indicated a weak positive correlation between CKI and CAI, a similar finding to that of Kraak et al. (2018), meaning there is lower possibility of there being a relationship between CKI and CAI. Findings from this study are consistent with that of youth female footballers showing good overall concussion knowledge and attitudes in women's football, good concussion knowledge does not correlate with improved self-reported behaviours (Kurowski et al., 2014). Similarly, Beidler et al. (2018) investigated concussion knowledge and reporting behaviours in 410 high school and college athletes and showed athletes displayed moderate to high levels of knowledge but that education did not correlate with good reporting behaviour. The most common reason for poor reporting was 'I did not think it was serious' (40%) and 'I did not want to lose playing time' (31%). This is even more important as shown by the results in this study with over a third of players (43%) with a history of SRC. This indicates a need for research to identify factors affecting athlete knowledge and attitudes towards concussion. This would allow for targeted education for concussion recognition and potential consequences as a result of an inappropriately assessed or managed concussions.

Education effectiveness

Education improves concussion knowledge but is not associated with improved self-reported behaviours (Kurowski et al., 2014). This is further backed by previous findings in the literature where Black et al. (2020) demonstrated that concussion education may be associated with small overall differences in concussion knowledge but this does not translate to significant differences in beliefs or behaviours in practice. Overall, this study adds that education in elite female footballers enhanced knowledge but does not enhance attitudes towards concussion.

Limitations

No personal characteristics were requested from participants in the survey. Therefore, player characteristics (e.g. nationality, age or playing position) were not controlled and were a true representation of the population analysed (Henderson and Page, 2007). The study was distributed in English only, which may have prevented some players from completing the survey due to language barriers. The study was a cross sectional study and therefore there is an inability to assess incidence due to data observed at a given point in time (Wang and Cheng, 2020).

Further Research

Further research is required to establish how improved knowledge can be translated into positive attitudes and behaviours relating to concussion. This would allow for educational interventions to focus on changing player attitudes in women's football. Exploring factors associated with poor knowledge and attitudes within elite female footballers might allow for individualised targeted educational interventions.

Conclusion

Results from elite female footballers included in this study demonstrate better knowledge and safer attitudes in comparison to results seen in other comparative studies. The key finding of this study is concussion education was shown to significantly improve knowledge of concussion in elite female footballers, but education did not affect attitudes towards concussion. This is key given nearly half the players reported a previous concussion. Therefore, concussion education should be mandated by governing bodies to enhance player welfare and outcomes. In doing so, the hope is this study will improve concussion attitudes and knowledge in women's elite football, address any concerns regarding concussion in this population, improve player engagement to the FA Concussion RTP pathways and ultimately, enhance player welfare and outcomes.

Data availability statement

The data that supports the findings of this study are available from the corresponding author, (AS). The data is not publicly available due to participants consenting only to anonymised extracts and aggregated data use, dissemination, and storage.

Declaration of interest statement

No funding was provided for this study.

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**** Figure 1 near here ****

Figure 1: A scatter plot showing the correlation between players CKI and CAI scores. The blue dots represent the correlation between the CKI score and CAI score. The straight line represents the weak positive correlation (r=0.2028).