

TITLE

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

AUTHOR

Shafik, Andrew; Bennett, Pippa; Rosenbloom, Craig; et al.

JOURNAL

Science and Medicine in Football

DATE DEPOSITED

26 January 2023

This version available at

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1 **Title**

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4
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31 **Competing interest's statement:**

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

34
35 **Contributorship:**

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

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49 Word count (Abstract) = 213
50 Word count (Main text) = 2,995
51 Table Count = 5
52 Figure Count = 1

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

55

56 **Abstract**

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

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

66 **Results:** One hundred and twenty three players completed the survey with 111 fitting
67 the inclusion criteria. The mean CKI score was 20.5 ± 2.3 and the mean CAI score was
68 63.3 ± 6.3 . A weak positive correlation was shown between the CKI and CAI ($r=0.20$;
69 $p=0.03$). Previous concussion education had a significant impact on increased
70 knowledge ($U=1198$; $p=0.04$). There was no significant difference in concussion attitudes
71 and knowledge between the WSL and Championship or in those with a previous
72 concussion history and no previous concussion ($p>0.05$).

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

77

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

80 **Introduction**

81 Sports-Related Concussion (SRC) is a traumatic brain injury defined as a complex
82 pathophysiological process affecting the brain, induced by biomechanical forces with
83 several common features that help define its nature (McCroory et al., 2017). Broglio et al.
84 (2010) showed a lack of understanding of concussion knowledge and attitudes in male
85 juvenile Italian club level footballers with 62% of concussions in this group unreported.
86 These results highlight a lack of concussion knowledge in academy level footballers and
87 signify the importance of understanding the attitudes and knowledge of concussion in
88 sport to improve player outcomes.

89 Okholm Kryger et al. (2021) highlighted the lack of comparable research from women's
90 to men's football and set out an agenda of determining research priorities for the
91 women's game. This finding is further reinforced with much of the SRC studies in the
92 literature conducted in the male population. A systematic review into the epidemiology
93 of SRC in female contact sports showed SRC rates of 2.08-4.04 per 1000 athletic
94 exposure events in women's football (Walshe et al., 2022). Further to this, players with
95 concussion education in elite English football was shown to be 48%, with education rates
96 shown to be significantly lower in women's football compared to men's football (27% and
97 51% respectively: Rosenbloom et al., 2021). This highlights a discrepancy between the
98 men's and women's game despite concussion education being recommended for
99 athletes following the most recent Concussion in Sport Group Consensus Statement
100 (Patricios et al., 2018). This is of concern given the documented risk in the literature of
101 multiple concussions being a risk factor for cognitive impairment and mental health
102 problems (Manley et al., 2017).

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

117 (>12 years) were all associated with better youth athlete concussion knowledge
118 (Register-Mihalik et al., 2018). This demonstrates the need to understand SRC
119 knowledge and attitudes to optimise player welfare. This is particularly important to note
120 given the risk of brain injury has been shown to be twice as likely in women's football in
121 comparison to men's football (McGroarty et al., 2020; Robson, 2021). The higher rates
122 of SRC in female athletes compared to male athletes is not fully understood (Mollayeva
123 et al., 2018), however, a recent systematic review looking at SRC in female athletes
124 suggested biomechanical and hormonal differences as possible contributing factors
125 (McGroarty et al., 2020).

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

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

144

145

146 **Methods**

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

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

152

153 ***Participants***

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

167

168 ***Survey design***

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

191 Sections one, two and five constitute the Concussion Knowledge Index (CKI). There was
192 a total of 25 questions and each question answered correctly scored one point for a total
193 score range of 0-25. Sections three and four constitute the Concussion Attitude Index
194 (CAI). These totaled 15 Likert scale (1-5) questions with participants receiving five points
195 for the safest answer and one point for the least safe answer for a total score range of
196 15-75. When calculating percentage answered correctly for CAI, safe answers were
197 those that scored 4 or 5 points.

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

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

206

207 ***Data Collection***

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

211

212 ***Data Analysis***

213 Descriptive statistics were analysed for the CKI (0-25) and CAI (15-75) scores with SPSS
214 Statistics (Version 27.0, (BM, Armonk, NY, USA). CKI and CAI scores were obtained
215 comparing, the WSL and Championship, previous concussion and no previous
216 concussion, and previous concussion education and no previous concussion education
217 for players. To explore the distribution of the data, the Kolmogorov-Smirnov test was
218 used as the total number of participants and number of participants in the sub-groups
219 ≥ 50 . The one exception to this where a sub-group < 50 was when comparing players CKI
220 and CAI in the previous concussion versus no previous concussion sub-groups. In this
221 setting, the Shapiro-Wilke test was used instead to explore the distribution of data (Anon,
222 2021). Normal distribution was seen for CAI ($P \leq 0.05$) whilst CKI scores were not
223 normally distributed ($P \geq 0.05$), hence CAI was assessed using an independent t-test and
224 CKI using a Mann-Whitney U test to test the differences between the two nominal groups.
225 The correlation between CKI and CAI was calculated using the Pearson Correlation
226 Coefficient (Mukaka, 2012).

227

228 **Results**

229 ***Participant Characteristics***

230 The survey was completed by 123 participants. Eleven participants were excluded for
231 not fully consenting to the survey and one further participant excluded for failing the VI,
232 leaving a total of n=111. Given the 111 player completed responses and a maximum of
233 25 players responses per club (totalling 575), there was an assumed response rate of
234 19% (111/575).

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

238

239 [**** Table 1 near here ****](#)

240

241 ***Concussion Knowledge Index RoCKAS Outcomes***

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

251

252 [**** Table 2 near here ****](#)

253 [**** Table 3 near here ****](#)

254

255 ***Concussion Attitude Index RoCKAS Outcomes***

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

262

263

264

265 ***Impact of league of competition***

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

270

271 ***Previous concussion history***

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

277

278 ***Previous concussion education***

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

285

286 ***Correlation between CKI V CAI scores***

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

289

290 **Discussion**

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

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

304

305

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

306

307 ***Overall knowledge and attitude***

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

317

318 ***Comparing knowledge and attitude***

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

335

336 **Education effectiveness**

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

344

345 **Limitations**

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

353

354 **Further Research**

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

360

361 **Conclusion**

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

372

373 **Data availability statement**

374

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

378

379 **Declaration of interest statement**

380

381 No funding was provided for this study.

382

383

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478 **** [Figure 1 near here](#) ****

479
480 *Figure 1: A scatter plot showing the correlation between players CKI and CAI scores.*
481 *The blue dots represent the correlation between the CKI score and CAI score. The*
482 *straight line represents the weak positive correlation (r=0.2028).*