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Knowledge, attitude, and behaviour around concussion at the FIFA Women's World Cup 2023: part 1 - medical staff

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ABSTRACT

The objective of this observational cross-sectional study was to assess the knowledge, attitudes and behaviours of medical staff participating in the FIFA Women's World Cup 2023 regarding the assessment and management of concussion in football. Medical staff from 32 teams qualified for the FIFA Women's World Cup 2023 were invited to answer an online survey. Results were analysed descriptively. 47 participants completed the survey. Concussion knowledge: 98% were aware of concussion protocol(s). Most concussive signs or symptoms were recognised, though only 36% of participants ($n = 17$) correctly reported potential symptom onset time. Knowledge on assessment and return to play elements varied. Attitude: 77% ($n = 36$) reported being very confident or confident in recognizing a suspected concussion. When assessing a suspected concussion on the pitch, 55% ($n = 26$) reported to have felt pressured by the player sometimes, very often or always, and 47% ($n = 22$) by the coaching staff. Behaviour: Among doctors, 70% reported their national team performs baseline concussion assessments. Reported use of on-field assessment elements suggested in concussion guidelines varied between 5% and 95%. In conclusion, most medical staff participating in the FIFA Women's World Cup 2023 were generally knowledgeable about concussion, reported on-pitch and return to play attitudes and behaviours aligning with evidence-based standards for safeguarding players' health. However, gaps were observed in all three domains, compared to guidelines. Expanding education to players and coaching staff is suggested to facilitate the delivery of evidence-based best practice.

ARTICLE HISTORY
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KEYWORDS
Head injury; women's football; national team; doctor; player

Introduction

Risks of sustaining a concussion in football are reported to be higher in female football players compared to their male counterparts (McGroarty et al. 2020; Bretzin et al. 2021), thus have been among the most researched injuries in the game (Okholm Kryger et al. 2023). With the aim to support medical staff with evidence-based assessment and management strategies for suspected concussion, multiple consensus statements and football-specific guidelines exist (Patricios et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]). They synthesise scientific knowledge into applied guidelines, which is an initial key step towards knowledge translation (Graham et al. 2006; Conaghan et al. 2021). However, the level of implementation of these guidelines (behaviour) will be influenced by practitioners' awareness of resources and content (knowledge), their confidence and intention to apply the knowledge (attitude) (Conaghan et al. 2021; Rosenbloom et al. 2022).

In football, the team medical staff is responsible for assessment and management of concussions on and off the field (FIFAFédération Internationale de Football Association [FIFA] [date unknown]). Team medical staff are, thus, expected to have in-depth knowledge of and ability to apply best practices guidelines. For example, a survey showed that 96% of medical staff from both men's and women's football in the United Kingdom were aware of the English Football Association's concussion guideline (Rosenbloom et al. 2022b). However, this same study showed inconsistencies between guidelines and practice. For instance, 17% of participants reported they would not perform baseline concussion assessments. Inconsistence with guidelines was even higher in another study with physicians working in professional football in Belgium, England, and France, where 63% reported they did not perform baseline assessments (Gouttebarge et al. 2021). Whether the gaps observed were influenced by a low level of knowledge about concussion assessment and return to play, by limitations in attitudes towards implementing best practices and/or by contextual factors is yet unknown. Moreover, regulations around education on concussion in football for medical staff differ between Confederations and National Associations, potentially leading to a heterogeneous level of training around

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concussion guideline implementation among national teams' medical practitioners.

Therefore, the objective of this study was to explore the knowledge, attitudes and behaviours regarding the assessment and management of concussion among medical staff attending the FIFA Women's World Cup Australia & New Zealand 2023.

Materials and methods

This study is part of a larger cross-sectional project aiming at assessing knowledge, attitudes, and behaviours of women's football national teams' professionals and players around concussion (see Part 2). Results were reported according to the checklist for reporting results of internet e-surveys (CHERRIES; Appendix A (Eysenbach 2004)).

Participants

The target participants of this cross-sectional study were medical staff (doctors, physiotherapists, sports therapists, athletic trainers) from the 32 national teams participating in the FIFA Women's World Cup 2023.

Ethics were granted by St Mary's University, Twickenham (SMU_ETHICS_2022-23_237). Participants were informed that they were free to withdraw from the research at any time before submitting the survey. They provided informed consent prior to starting the survey. No incentives were offered for participation. All information was deidentified.

Survey development

The survey was initially developed by CW, KK, AS, AM, AMcC and MF inspired by previous football-specific concussion knowledge, attitude and behaviour surveys (Rosenbaum and Arnett 2010; Rosenbloom et al. 2022), and the FIFA Concussion Protocol (FIFAFédération Internationale de Football Association [date unknown]). Relevance of each question to the proposed aims and respective content validity (Rattray and Jones 2007) were later assessed by all the authors, and changes were made until agreement. Technical functionality was assessed by CW, KK, AS and AMcC.

The survey comprised 42 questions displayed in eight online sections: 1) Informed consent, 2) participants' demographics, 3) football-specific concussion education, 4) knowledge of a) initial assessment of suspected concussion, b) concussion management, c) concussion-specific FIFA Women's World Cup 2023 rules and regulations, 5) attitude towards a) initial assessment of suspected concussion, b) concussion management, c) concussion-specific FIFA Women's World Cup 2023 rules and regulations, 6) current practices on initial assessment and management, 7) suggestions for FIFA regarding concussion-specific initiatives, and 8) confirmation of answer submission (Appendix B). To reduce complexity of the survey visualization, some questions were displayed based on responses to previous items. Expected time for completion was between 20 to 30 minutes. Answering all questions was mandatory to progress in the survey (except for page 7), and participants were not able to return pages to review their responses before submission. Sections 2, 3, 4a, 4b, 5a, 5b and 6 were analysed to answer the objective of this paper.

The survey was developed in English. A pilot study to test clarity and usability of the survey was done with medical staff from an A-league women's football team in New Zealand. As a result, corrections were made to one functionality and one spelling mistake, one answer option was included, one was excluded, and one question was amended for clarity. The final English version was translated into the official FIFA languages: French, Spanish, Portuguese, German, and Arabic. Vietnamese and Japanese language versions were later included upon request from National Associations.

Survey distribution

An online survey domain approved by the General Data Protection Regulation was used to distribute the surveys (JISC, Bristol, United Kingdom). A participation invitation e-mail including its aims, ethical considerations, and the surveys' link was sent to representatives from each National Association attending the FIFA Women's World Cup 2023. They were asked to forward the invitation to respective medical professionals expected to take part in the tournament for their national team. No password was needed to access the survey. They were opened for responses from April 3rd to 31 May 2023. Reminders were sent twice (April 26th and May 23rd).

Data analysis

Only complete surveys data were stored and analysed. Raw data were exported to Microsoft® Excel® (Microsoft® 365, Redmond, WA). Closed-ended questions were analysed descriptively (count and percentages relative to the number of participants). Time taken to answer the survey is presented as median and interquartile intervals. Open-ended questions were analysed using content analysis, as follows (Hsieh and Shannon 2005; Patton 2015).

Analysis followed a direct approach in questions where answers were expected to match the Consensus Statement on Concussion in Sport (Walden et al. 2023) or the FIFA concussion guideline (Fédération Internationale de Football Association [FIFA] [date unknown]). Specifically, the initial codes for questions 12–15 and 18 (Appendix C) were defined by two researchers (CW and KK) based on the FIFA concussion guideline. Coding was performed by CW and later discussed with KK (questions 13–15,18), CR and SC (question 12). Questions about participants' experiences and opinions (i.e., 26.1, 27.1, 28.1, 28.2, 41.1 and 42) were analysed using an inductive content analysis. Codes relative to each answer were progressively combined or amended until saturation by CW, and later discussed with KK (Appendix C). Questions 16, 36 and 40 were not analysed for this paper. Part of the responses to questions 16 and 36 did not allow comparison with best-practices guidelines, and question 40 was amended during the

Table 1. Respondent's demographics, respective experience in elite women's football, awareness of sports-related concussion protocols, and education on concussion.

	Total n (%)	AFC n (%)	CAF n (%)	CONMEBOL n (%)	Concacaf n (%)	OFC n (%)	UEFA n (%)
Number of participants	**47**	**6 (13%)**	**6 (13%)**	**6 (13%)**	**2 (4%)**	**3 (6%)**	**24 (51%)**
Doctors	27	4 (15%)	4 (15%)	5 (19%)	0 (0%)	2 (7%)	12 (44%)
Other medical staff	20	2 (10%)	2 (10%)	1 (5%)	2 (10%)	1 (5%)	12 (60%)
Years working in international women's football at senior level							
<1 year	6 (13%)	1 (17%)	2 (33%)	1 (17%)	1 (17%)	1 (17%)	–
1–4 years	14 (30%)	2 (14%)	1 (7%)	3 (21%)	1 (7%)	1 (7%)	6 (43%)
4–8 years	15 (32%)	2 (13%)	2 (13%)	1 (7%)	–	–	10 (67%)
>8 years	12 (26%)	1 (8%)	1 (8%)	1 (8%)	–	1 (8%)	8 (67%)
Aware of any sports-related concussion protocols							
Total	**46 (98%)**	**6 (100%)**	**6 (100%)**	**6 (100%)**	**2 (100%)**	**3 (100%)**	**23 (96%)**
FIFA Concussion protocol	11 (24%)	1 (9%)	–	1 (9%)	–	2 (18%)	7 (64%)
Consensus statement on concussion in sport	4 (9%)	–	–	–	–	1 (25%)	3 (75%)
Sport Concussion Assessment Tool (Cezarino et al. (2020))	26 (57%)	4 (15%)	4 (15%)	4 (15%)	2 (8%)	–	12 (46%)
Confederation's protocol	4 (9%)	–	–	1 (25%)	–	–	3 (75%)
National Association's protocol	7 (15%)	–	1 (14%)	(29%)	–	1 (14%)	4 (57%)
Other protocol	7 (15%)	–	1 (14%)	–	(14%)	2 (29%)	3 (43%)
Have participated in football-specific concussion education							
Total	**31 (66%)**	**2 (6%)**	**3 (10%)**	**2 (6%)**	**2 (6%)**	**2 (6%)**	**20 (65%)**
1 year or less	25 (81%)	1 (4%)	1 (4%)	2 (8%)	1 (4%)	2 (8%)	18 (72%)
More than 1 year	6 (19%)	1 (17%)	2 (33%)	–	1 (17%)	–	2 (33%)

*Percentage in 'Total' columns: 'Years in international women's football at senior level', 'Total' in 'Aware of any sports-related concussion protocol(s)' and 'Have participated in football-specific concussion education' = Percentage calculated from total number of participants ($n = 47$). Other rows within 'Aware of any sports-related concussion protocol(s)' and 'Have participated in football-specific concussion education': Percentage calculated from respective totals. Confederations' columns = % represents the percentage from the column 'Total' in each row. Other medical staff = physiotherapists, therapists, athletic trainers.

development of the survey and should have been removed in the final version.

Results

Participant demographics

A total of 47 medical staff members (34% of the 139 medical staff attending the FIFA Women's World Cup 2023) completed the survey (Table 1). These included 27 doctors (50% of doctors attending the FIFA Women's World Cup 2023) and 20 other members from the medical staff (17 physiotherapists, two athletic trainers, and one sports therapist; 24% of all other medical staff attending the FIFA Women's World Cup 2023; Table 1). Number of participants from each Confederation are detailed in Table 1. Median time for completion was 35 min (IQ = 22.7–47.7 min).

One doctor (4%) and eight other medical staff (40%) reported to be employed full-time by their national teams. The majority of doctors that answered to the survey (74%, $n = 20$) and half of other medical staff (50%, $n = 10$) reported to be part-time, whereas 22% ($n = 6$) of doctors and 10% ($n = 2$) of other medical staff reported other employment agreements, respectively.

Awareness of concussion and concussion protocols

Among medical staff, 87% ($n = 41$) of participants (doctors 89%, $n = 24$; other medical staff, 85%, $n = 17$) reported to have previously assessed a suspected concussion.

All but one respondent (98%, $n = 46$) reported to be aware of at least one sports-related concussion protocol (Table 1). From these, various versions of the Sport Concussion Assessment Tool (Cezarino et al. 2020) were the most frequently mentioned (57%, $n = 26$), followed by the FIFA Concussion protocol (FIFA) (24%, $n = 11$; Table 1).

Football-specific concussion education

Two thirds (66%, $n = 31$) reported to have previously attended football-specific concussion education. From these attendees, 81% ($n = 25$) had completed or updated education within the past year (Table 1). All participants agreed that better education of coaches and players on their team can assist the medical staff in assessing and managing on-pitch concussion. Similar trends were seen for education of performance staff (89%, $n = 42$), and administrative staff (57%, $n = 27$).

Knowledge of concussion symptoms

All 47 participants were asked to list six signs or symptoms of a possible concussion. From these, six participants gave one response that was not a recognised concussive sign or symptom (FIFA): four described trauma to face or head; two answers were unclear; and one answered with a question mark. The most cited signs or symptoms were headache and balance disturbances (Figure 1(a)). The correct and complete onset time of concussion (i.e., immediate to 2–3 days) (Patricios et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]) was provided by 36% of participants ($n = 17$; Figure 1(b)); doctors: 26%, $n = 7$; other medical staff: 50%, $n = 10$).

Knowledge of concussion assessment and return to play elements

The time allowed for on-pitch concussion assessment (3 minutes) was correctly reported by 55% of participants

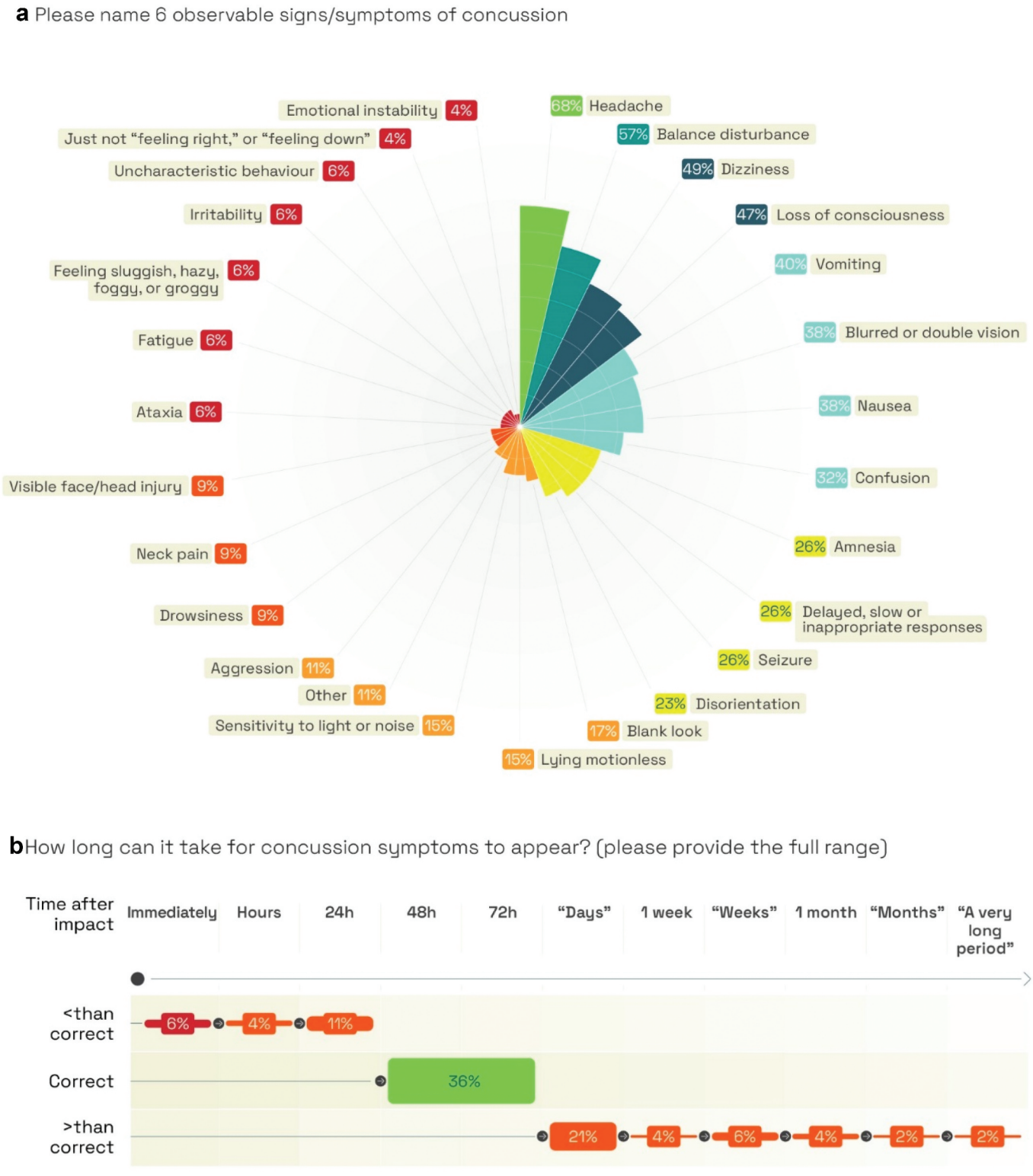

Figure 1. Knowledge of (a) Observable signs and symptoms of concussion, and (b) Time of symptoms onset.

(Figure 2; doctors: 59%, $n = 16$; other medical staff: 50%, $n = 10$). When asked to describe the components of key assessment elements, most participants correctly reported the three components of the Glasgow Coma Scale (Figure 2; doctors: 93%, $n = 25$; other medical staff: 85%, $n = 17$), whilst half correctly reported the five Maddocks' questions (Figure 2; doctors: 48%, $n = 13$; other medical staff: 55%, $n = 11$). The number of stages in the graduated return to play protocol was correctly reported by 77% of participants (Figure 2; doctors = 81%, $n = 22$; other medical staff = 70%, $n = 14$) and the number of stages that can be completed in one day if there are no clinical concerns by

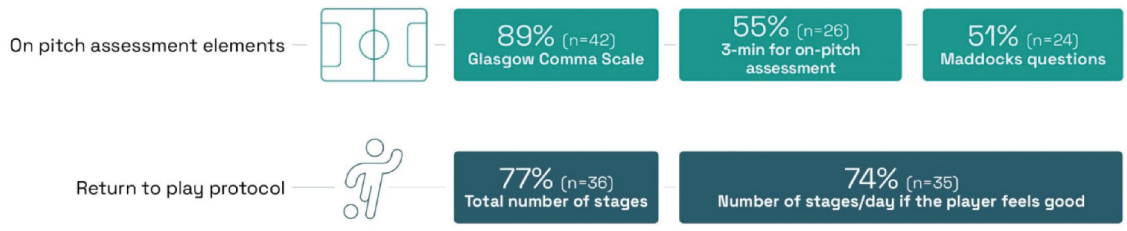

Figure 2. Percentage of medical staff that answered correctly and completely to concussion assessment and return to play elements.

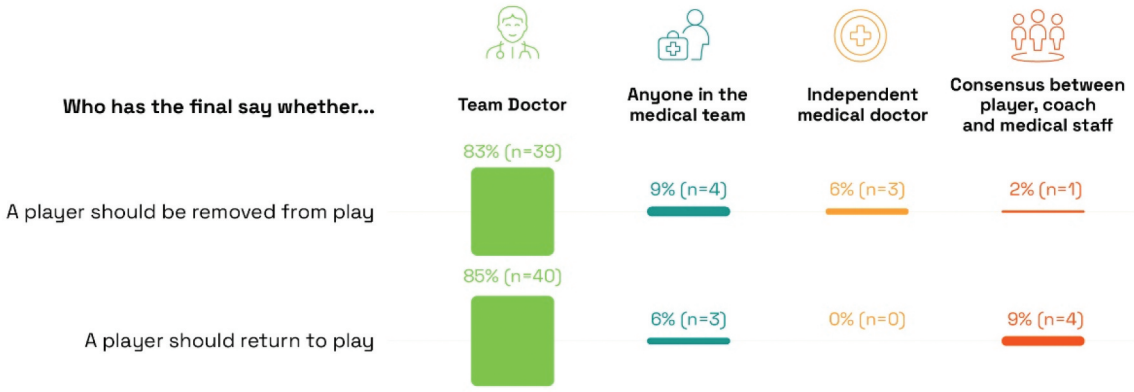

Figure 3. Knowledge of responsibility over concussion-related decisions. Answers to the questions '*who has the final say about whether a player with suspected concussion should be removed from play?*', and '*who has the final say about the return-to-play management of a concussed player?*'.

74% (Figure 2; doctors: 78%, $n = 21$; other medical staff = 70%, $n = 14$).

Knowledge of decision-making around concussion

Team doctors were considered responsible for the final say about whether a player with suspected concussion should be removed from the pitch by 83% ($n = 39$) of participants, and for the decision on players' return to play by 85% ($n = 40$). The remaining responses indicated other stakeholders (Figure 3).

Knowledge of risks related to concussion

Most medical staff correctly identified potential risks related to players sustaining a concussion. These included 74% ($n = 35$) correctly identifying an 'increased likelihood to have another concussion after a first one' and 100% ($n = 47$) correctly identifying 'risk to long-term health and wellbeing from multiple concussions'. The risks of complications if a player returns to play too soon after a concussion included 'brain damage' (correctly identified by 85%, $n = 40$), 'concussion symptoms persisting long term' (correctly identified by 100%, $n = 47$) and the false risk of 'paralysis' (correctly identified by 34%, $n = 16$; Table 2). All respondents correctly identified 'Reduced sports performance' as a possible consequence of returning to play too soon after a suspected concussion.

Confidence in concussion assessment

Three quarters (77%, $n = 36$) of participants reported to feel very confident or confident in recognising a suspected

Table 2. Knowledge of risks related to concussion.

	Correct		Incorrect		Not sure	
	%	n	%	n	%	n
Risks related to sustaining a concussion						
There is a possible risk of death if a second concussion occurs before the first one has healed. (*correct = true*)	77%	36	13%	6	11%	5
People who have had one concussion are more likely to have another concussion. (*correct = true*)	74%	35	19%	9	6%	3
A concussion can only occur if there is a direct hit to the head. (*correct = false*)	91%	43	9%	4	0%	0
There is a risk to long-term health and well-being from multiple concussions. (*correct = true*)	100%	47	0%	0	0%	0
Risks related to complications of returning to play too soon after a suspected concussion						
No complications exist (*correct = false*)	100%	47	0%	0	0%	0
Increased risk of further injury (*correct = true*)	94%	44	4%	2	0%	0
Paralysis (*correct = false*)	34%	16	43%	20	23%	11
Brain damage (*correct = true*)	85%	40	6%	3	9%	4
Reduced sports performance (*correct = true*)	100%	47	0%	0	0%	0
Concussion symptoms persisting long term (*correct = true*)	100%	47	0%	0	0%	0

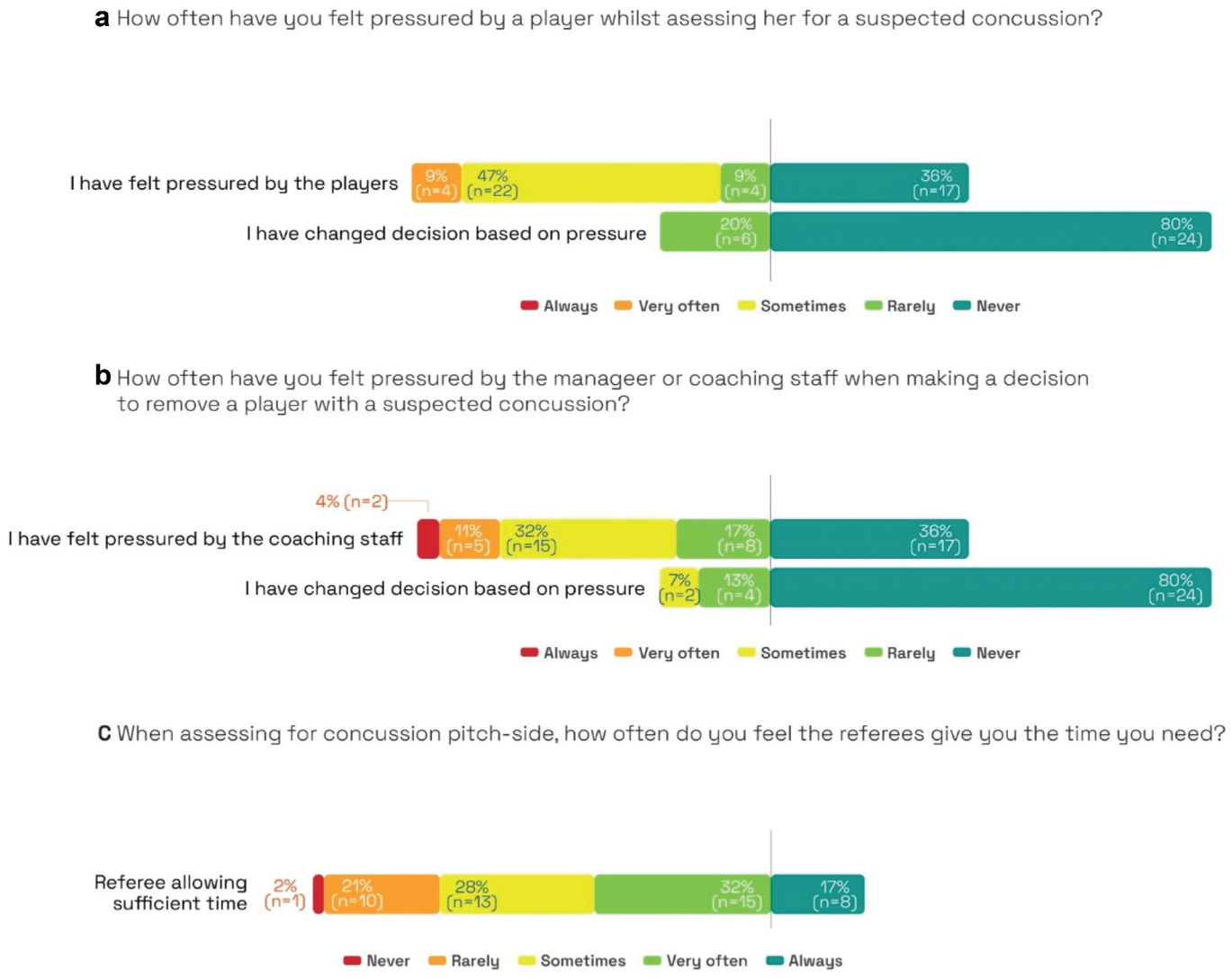

Figure 4. Experience with perceived pressure from (a) Players, (b) Coaching staff and (c) Referees. Percentage of responses related to change of decision was calculated based on participants who answered having felt pressured at least rarely in the previous question.

concussion (doctors: 85%, $n = 23$, other medical staff: 65%, $n = 13$), with the remaining 23% ($n = 11$) of participants (doctors: 15%, $n = 4$, other medical staff: 35%, $n = 7$) reporting to feel neither confident nor unconfident.

Perception of pressure from stakeholders on initial assessment

Pressure from the player when deciding on whether to remove her from play due to suspected concussion had previously been experienced by 55% ($n = 26$) of participants *sometimes*, *very often* or *always* (Figure 4(a); doctors: 41%, $n = 11$; other medical staff 75%, $n = 15$). These practitioners reported having perceived the pressure: (i) in important matches, and (ii) as a result of different behaviours from the players: player willing or requiring continuing playing; player downplaying, under-reporting or not reporting symptoms; and player adding time pressure for assessment. Additionally, 20% ($n = 6$) of those perceiving pressure reported to have changed their decision either sometimes or rarely (Figure 4(a); doctors: 14%, $n = 2$; other medical staff 25%, $n = 4$).

Having previously felt pressured by the coaching staff was reported by 47% of participants (n = 22) either *sometimes*, *very often* or *always* (doctors: 33%, $n = 9$; other medical staff: 65%, $n = 13$; Figure 4(b)). Among these, participants reported that the pressure occurred (i) in important matches; (ii) described the pressure as non-verbal or as verbal (e.g., placing time pressure for assessment; attenuating symptoms' severity; questioning their decision; pressurizing the player's return to play). Those who reported having changed their decisions if they perceived pressure from the coaching staff (*rarely* or *sometimes*) were 20% ($n = 6$; doctors: 20%, $n = 3$; other medical staff: 20%, $n = 3$).

Regarding perception of the time given by referees for on-pitch assessment, 83% ($n = 39$) of participants reported they are not always given sufficient time (Figure 4(c); doctors: 74%, $n = 20$; other medical staff: 95%, $n = 19$).

Other barriers to suspected concussion's assessment and decision-making were reported by 9 participants: (i) limitations from the professional assessing the player (i.e., lack of knowledge, uncertain about decision and unclear symptom); (ii) limitation from the team (i.e., lack of baseline assessment), and (iii)

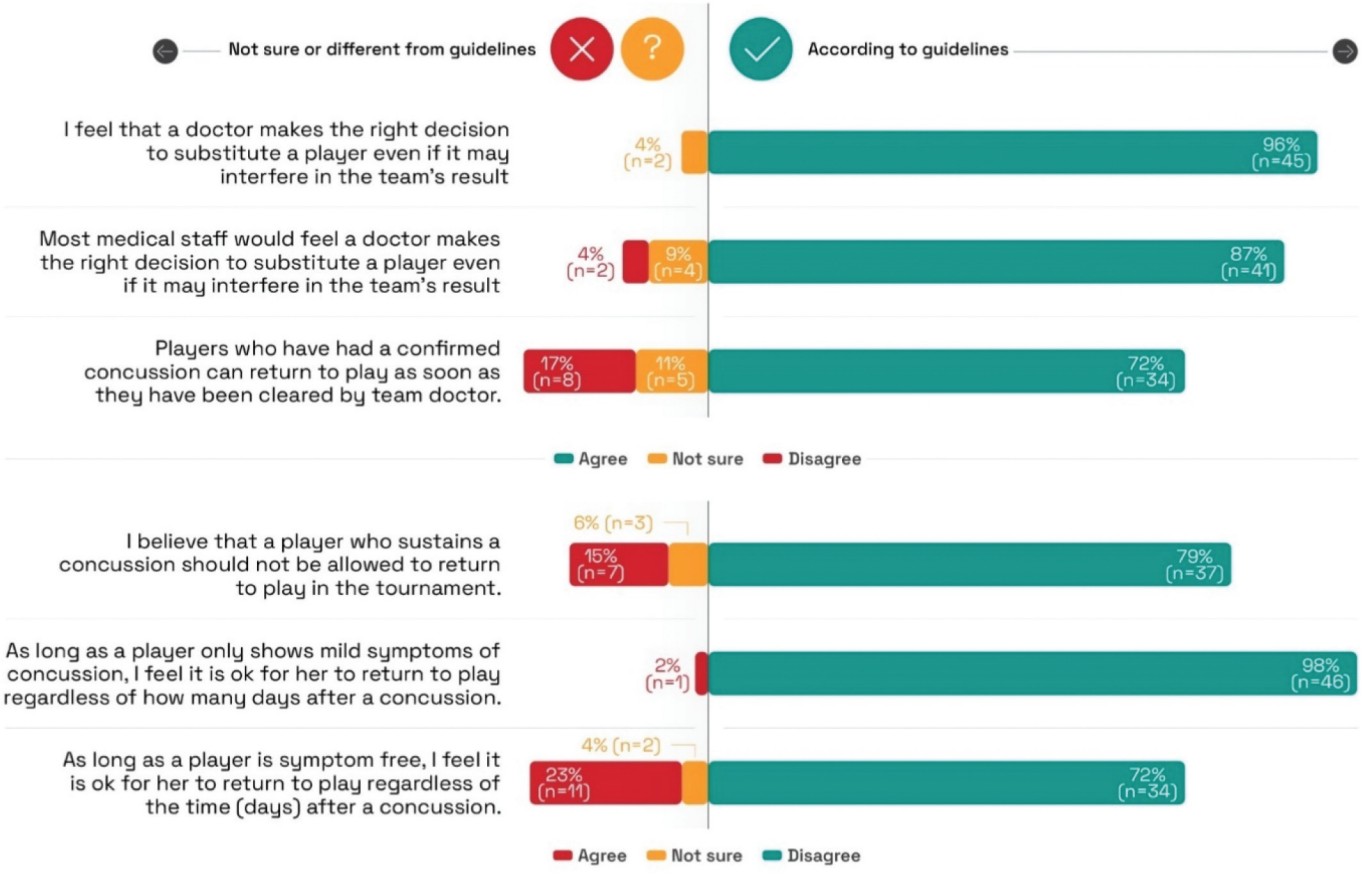

Figure 5. Attitude towards decision-making on concussion assessment and return to play.

limitations from the match organisation (i.e., lack of supporting tools, restricted time for assessment, and unclear regulations).

Attitude towards decision-making on concussion assessment and return to play

Nearly all participants (96%, $n = 45$) agreed that a doctor should remove a concussed player from the pitch even if it may interfere with the team's result. Answers to statements regarding criteria for players' return to play varied among participants (Figure 5). For instance, 28% ($n = 13$) disagreed or were not sure that players who have had a confirmed concussion can return to play as soon as they have been cleared by team doctor.

Baseline assessments practices

Amongst doctors, 70% ($n = 19$) reported that their national team performs concussion baseline assessments, whilst 11% ($n = 3$) reported they do not perform them, and 19% ($n = 5$) were not sure. Amongst the 19 doctors reporting to perform baseline tests, 95% reported to use the Sport Concussion Assessment Tool (SCAT; $n = 18$), 5% ($n = 1$) vestibular/ocular-motor screening, 5% ($n = 1$) reaction time, and 5% ($n = 1$) reported neuropsychological tests, without specifying which ones.

All doctors that reported performing baseline assessments (70%, $n = 19$) reported using the same tools to support their decision to clear a player to return to play, with two of them also adding a second test on the return to play assessment. Altogether, 96% ($n = 26$) of doctors reported using at least one assessment tool to support their decision to clear a player to return to play, and one doctor (4%) reported to not use any assessments.

On-pitch assessment practices

Participants were asked to select from a list of options which ones they use to assess a player for a suspected concussion. Some elements from the FIFA Concussion Protocol (FIFA) were included in the list (Table 3, marked with '*'), and were selected by 7% to 89% of doctors, and 5% to 95% of other medical staff that participated in this study. When assessing a player for a suspected concussion on the pitch, more than 70% of doctors reported to perform: a discussion with the player about possible symptoms, the Maddocks' questions, the Glasgow Coma Scale, palpation of the cervical spine, cervical movement, and motor function assessment (Table 3). Proportion of other medical staff using selected on-pitch assessment elements differed, with more than 70% reporting to have a discussion with the player about possible symptoms, and to use the Maddocks' questions (Table 3).

Return to play practices

Three participants (6%; doctors: 4%, $n = 1$; other medical staff: 10%, $n = 2$) reported to allow a player to return to play before completing a graduated return to play protocol

Table 3. Elements used during on-field assessment of a suspected concussion, ordered by their percentage use from doctors and other medical staff.

Doctors			Other medical staff		
On-field assessment element	%	n	On-field assessment element	%	n
Maddocks questions*	89%	24	Maddocks questions*	95%	19
Palpation of the cervical spine*	85%	23	A discussion with the player about possible symptoms*	70%	14
A discussion with the player about possible symptoms*	81%	22	Palpation of the cervical spine*	65%	13
Assessment of cervical movements*	78%	21	Glasgow Coma Scale*	65%	13
Glasgow Coma Scale*	78%	21	Assessment of cervical movements*	60%	12
Assessment of motor function*	70%	19	A review of video footage of incident	55%	11
Assessment of sensation/light touch*	56%	15	Assessment of motor function*	50%	10
A review of video footage of incident	41%	11	Assessment of sensation/light touch*	50%	10
Modified balance error scoring system*	26%	7	Finger nose coordination test*	30%	6
Finger nose coordination test*	26%	7	Modified balance error scoring system*	25%	5
Immediate memory (5- or 10-word trial list)	19%	5	Digits backwards	20%	4
Tandem gait assessment	11%	3	Immediate memory (5- or 10-word trial list)	15%	3
Complete standardised assessment of concussion (SAC) tool	7%	2	Tandem gait assessment	15%	3
Digits backwards	7%	2	Complete standardised assessment of concussion (SAC) tool	10%	2
Assessment of reflexes	7%	2	Assessment of reflexes	5%	1
Assessment of tone*	7%	2	Assessment of tone*	5%	1
Other tools/strategies	7%	2	Other tools/strategies	5%	1
The use of smelling salts	0	0	Assessment of GPS data	5%	1
Assessment of GPS data	0	0	The use of smelling salts	0	0
Use of VR goggles	0	0	Use of VR goggles	0	0
Computer based assessment tool	0	0	Computer based assessment tool	0	0

*Elements from the FIFA Concussion Protocol (FIFA). Other medical staff: physiotherapists, athletic trainers, sports therapists.

in case of 'important games', 'absence of symptoms and pressure of the athlete' and 'lack of knowledge'. The remaining 94% ($n = 44$) of participants stated they do not allow players to return to play before completing a graduated return to play protocol (doctors: 96%, $n = 26$; other medical staff: 90%, $n = 18$).

Discussion

This study aimed to assess concussion knowledge, attitudes, and behaviours among medical staff prior to participating in the FIFA Women's World Cup 2023. The results of the current study demonstrated overall appropriate knowledge, attitudes, and practices in line with evidence-based guidelines. Specifically, almost all medical staff (98%) were aware of at least one established sports-related concussion protocol; most were shown to be knowledgeable about observable symptoms and the risks associated with concussion. The reported attitudes of most medical staff suggested prioritising players' health when faced with a suspected concussion on the pitch despite some expressed having experienced pressure from coaching staff and players. Finally, most reported to perform baseline assessments, to conduct key on-pitch assessment elements, and to follow the graduated return to play protocol. However, we have identified areas where a substantial number of participants' answers diverged from evidence-based guidelines, specifically (i) knowledge of symptom onset time and certain aspects of the on-pitch assessment; and (ii) attitudes related to return to play.

Knowledge of concussion assessment and return to play

Participants were able to identify evidence-based signs and symptoms of concussion (Patricios et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]), though less than half correctly identified that these can by delayed by 2–3 days after the injury occurred (Patricios et al. 2023; Silverberg et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]). Additionally, only approximately half of medical staff were aware of the time available for on-pitch assessment or were able to correctly recall the Maddocks' questions (Patricios et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]). Considering almost all medical staff reported to be aware of sports-related concussion protocols, such low scores on key assessment elements suggests a gap in retention of protocols' information. Previous studies showed similar awareness rates of concussion protocols in the UK (97% and 96%; 8, 9) though level of knowledge from medical practitioners has not been assessed. Concussion-specific education has been proven an effective strategy to improve knowledge of coaches and officials (Yeo et al. 2020; Conaghan et al. 2021). Therefore, we suggest key knowledge gaps identified herein are used as benchmark for educational campaigns targeting elite women's football medical staff, and that their effectiveness is tested in this cohort.

Attitude towards concussion assessment and return to play

We observed a higher rate of doctors reporting to be confident or very confident in recognizing a suspected concussion (85%) compared to other medical staff (65%), which is not surprising due to their responsibility over concussion-related decision-making (FIFA). Observed confidence rates of UK elite football medical staff to recognize a suspected concussion (94% (Rosenbloom et al. 2022a, 2022b); and managing return to play (93% (Rosenbloom et al. 2022a, 2022b); were higher. Limitations in concussion knowledge found here may underpin the lower confidence rate in recognizing a concussion, though previous results are not available for comparison. Considering

that self-efficacy is a relevant aspect in implementation of evidence-based guidelines (Feldstein and Glasgow 2008), these results reinforce the importance of ongoing concussion-education for medical staff (DeMatteo et al. 2015; Rosenbloom et al. 2022).

Regarding perceived pressure from stakeholders, approximately a third to half of the medical staff reported having felt sometimes, very often, or always pressurized by the coaching staff (47%) and by an injured player (55%) when assessing for a suspected concussion. Perception of players' pressure included the downplaying, underreporting, or not reporting symptoms, which have been extensively shown in studies on concussion in sport (Williams et al. 2016; Gouttebarge et al. 2021; Rosenbloom et al. 2022; Tadmor et al. 2023). This raises great concern due to the self-reporting nature of key elements of concussion assessment (Patricios et al. 2023; Fédération Internationale de Football Association [FIFA] [date unknown]). Additionally, while in small number, our results show that such pressure can sometimes convince doctors to change their decisions on removing a player with a suspected concussion from the pitch. Altogether, these results illustrate the complex intricate of medical staff's, players' and coaches' attitudes towards protective behaviours around concussion. Participants in this study agreed that education of players, coaches (100%) and performance staff (89%) would assist the medical staff in assessing and managing on-pitch concussion. However, its effect on attitudes has been shown limited (Conaghan et al. 2021), and further research exploring limiting factors for safe attitudes from key stakeholders and effective interventions to influence them can support football organizations to develop context-specific strategies.

Practices around concussion assessment and management

Baseline concussion assessments were reported to be performed in their national teams by 70% of doctors, and 96% reported to use at least one assessment to support their decision on whether a player is ready to return to play. The recent concussion consensus statement (Patricios et al. 2023) suggest that baseline assessment should be performed when possible, allowing safer return to play through comparison of post- and pre-injury results. In addition, FIFA (FIFA) recommends using the newest version of the Sport Concussion Assessment Tool for baseline examinations for all teams. The exchange of such medical information between clubs and national teams can benefit players' health and performance (McCall et al. 2022), including concussion identification and management in both environments.

Elements reported to be used by most medical staff during on-pitch assessment are consistent with the most recent (Patricios et al. 2023) and football-specific (FIFA) concussion protocols. However, key elements were not reported by a considerable number of participants (e.g., approximately 30% did not report using the Glasgow Coma Scale). Such limited implementation could reflect the gaps in knowledge, though some may have an attitude or clinical choice underpin (e.g., adequate knowledge of the Glasgow Comma Scale was shown by 89% of participants, whereas only 70% reported to use it during their on-pitch assessment). Further research exploring the reasons for selection of on-pitch assessment element can contribute to development of education materials in the topic.

Strengths and limitations

This is the first study to investigate knowledge, attitudes and behaviours of medical staff working in international women's football. Due to the collection of strictly de-identifiable information to avoid perceived pressure disengaging participation, the chance of staff submitting two answers could not be prevented, though no identical answers were observed. Additionally, not identifying the responders' national teams limits the overview of participating countries, though all confederations were represented. The response rate was 34%, introducing the possibility of response bias. Also, it is important to highlight that the results may not be generalisable to National Associations that did not qualify for the FIFA Women's World Cup.

Conclusion

Results from our study suggest that most medical staff participating in the FIFA Women's World Cup 2023 were generally knowledgeable about concussion assessment and management. Most reported on-pitch and return to play attitudes and behaviours aligning with FIFA standards for safeguarding players' health. However, gaps were observed, especially around knowledge of symptoms' onset time, elements of on-pitch assessment; and in attitudes towards return to play. These topics can be considered as an initial focus for ongoing education programs designed to medical staff working in elite women's football. Finally, expanding education to players and coaching staff is suggested to facilitate the delivery of evidence-based practice.

Practical application

The results suggest that women's football medical staff would benefit from ongoing football-specific concussion education even at the highest level of the sport globally; and that concomitant education of players and coaching staff can facilitate attitudes and behaviours towards removing a player with a suspected concussion from the pitch, and towards adequate return to play.

The results from this study were presented to all national team doctors during the FIFA Women's World Cup 2023 pre-tournament meeting followed by a detailed description of the FIFA Concussion Protocol and educational videos which were developed with consideration of the survey results. A wider concussion awareness program with content tailored towards the findings of this study is also being developed by FIFA. To be effective globally, Confederations, National Associations, stakeholders' unions, and clubs should also adopt this and context-tailored education, in a joint effort towards safeguarding players' health. Understanding the effectiveness of such programs can foster their continuous improvement and expand a culture where concussions in football are always taken seriously and management is continuously improved.

Beyond the scope of this study, key gaps in knowledge, attitudes and behaviours may differ by country and level of competition, thus investigating local needs for education may potentiate positive impact when implementing education initiatives.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

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