Knowledge about sports-related concussion: is the message getting through to coaches and trainers?

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ABSTRACT

Aim The need for accurate diagnosis and appropriate return-to-play decisions following a concussion in sports has prompted the dissemination of guidelines to assist managing this condition. This study aimed to assess whether key messages within these guidelines are reflected in the knowledge of coaches and sports trainers involved in community sport.

Methods An online knowledge survey was widely promoted across Australia in May–August 2012 targeting community Australian Football (AF) and Rugby League (RL) coaches and sports trainers. 260 AF coaches, 161 AF sports trainers, 267 RL coaches and 228 RL sports trainers completed the survey. Knowledge scores were constructed from Likert scales and compared across football codes and respondent groups.

Results General concussion knowledge did not differ across codes but sports trainers had higher levels than did coaches. There were no significant differences in either concussion symptoms or concussion management knowledge across codes or team roles. Over 90% of respondents correctly identified five of the eight key signs or symptoms of concussion. Fewer than 50% recognised the increased risk of another concussion following an initial concussion. Most incorrectly believed or were uncertain that scans typically show damage to the brain after a concussion occurs. Fewer than 25% recognised, and >40% were uncertain that younger players typically take longer to recover from concussion than adults.

Conclusions The key messages from published concussion management guidelines have not reached community sports coaches and sports trainers. This needs to be redressed to maximise the safety of all of those involved in community sport.

INTRODUCTION

Sports-related concussion is receiving increasing global attention in both the lay press and scientific literature, particularly in relation to the various football codes.[1] The need for accurate diagnosis and appropriate management of concussion, as well as growing concern about potential long-term effects of sports-related concussion, has prompted the dissemination of guidelines to assist in the management of this condition.[2] It is not clear, however, whether the key messages from the guidelines are impacting directly on the knowledge and practices of target groups.[1]

Recent data from Victoria, Australia indicates that the rate of hospitalisations for sport-related concussion have increased significantly over the past 9 years.[3] Although the exact incidence of sport-related concussion is unknown, epidemiological studies suggest that football codes played in Australia (eg, Australian Football (AF) and Rugby League (RL)) have a 10-fold to 15-fold higher rate of concussion than does American football.[4 5] The AF and RL football codes are popular in Australia and are characterised by fast paced running-based actions, tackling of players and body contact during physical contests for control of the ball. Both sports are played at the professional and community levels, with estimates of 2.6% (n=447 300) of all Australians aged 15+ years in 2010 participating in AF and 1.0% (n=178700) in organised RL.[6]

Like other sports governing bodies, the Australian Football League (AFL) and the National Rugby League (NRL) have developed evidence-based guidelines for best practice concussion management in their sports and have made them available on their websites. At the time of this study, both the AFL and NRL guidelines were based on the 2008 International Consensus Statement on Concussion in Sport.[7] The guidelines specifically outlined game-day management of concussion, including recognition of the injury, permanent removal of the player with concussion from the game and referral of the player to a medical doctor for assessment. They also outlined how concussion should be managed postgame day and included return-to-play guidelines that stipulate that players must have medical clearance before returning and should do so using a gradual stepwise approach with a particular emphasis on remaining symptom free. The guidelines also recognised the importance of community clubs, coaches and other support staff in ensuring that players with a suspected concussion are managed appropriately.

The AFL and NRL have disseminated their respective concussion guidelines to the community through their websites and have stated that all those responsible for managing players with concussion (eg, coaches, medical staff, allied health and first aid support, parents, etc) should adhere to these guidelines. However, the impact of the availability of these guidelines on concussion management knowledge or practices in Australian football is largely unknown.

Previous studies have identified gaps in coaches' knowledge of concussion signs/symptoms, management and when it is safe to return-to-play.[8–11] These studies were conducted in Canada, Italy, New Zealand and the USA and covered ice hockey, soccer, rugby union and various high school sports. There have been no prior studies investigating coaches' or sports first aid providers' concussion knowledge in the context of the popular football codes in Australia. The purpose of this study was to

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describe the concussion knowledge of AF and RL coaches and sports trainers (C+ST) to identify any gaps in knowledge and misconceptions that need to be redressed to improve safety following concussion in community sports.

METHODS

Individuals were eligible to participate in the study if they were aged 18+ years and were a registered C+ST at a community AF or RL club. The Institutional Human Research Ethics Committee approved this study.

An online survey was developed using the Qualtrics software package (Qualtrics, Provo, Utah, USA). Before administration, the survey was reviewed for content and face validity by eight experts in the field of sport-related concussion or survey research, or with direct experience working with C+ST. Invitations to complete the survey were disseminated Australia-wide through recruitment notices placed on the AFL and NRL websites, electronic newsletters/alerts/direct emails to registered AF and RL coaches and Sports Medicine Australia's network of sports trainers, twitter feeds etc. In 2012, Australia-wide, there were 17 382 registered RL coaches and 33 390 registered RL sports trainers. The corresponding number of AFL coaches was approximately 25 000. The number of AFL sports trainers is unknown, but is likely that every club Australia-wide had at least one sports trainer. The online survey was live between 9 May 2012 and 31 August 2012.

Fifteen questions, informed by a review of the literature[9 11 12] and a previous survey,[13] were developed to assess general concussion knowledge (GCK). Responses were indicated on five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree), and incorrect knowledge statements were reverse-coded such that higher scores reflected more accurate knowledge about concussion. Scores were summed to generate a total GCK score for each respondent (ranging from 15 to 75).

A 24-item checklist (including the most commonly reported signs and symptoms of concussion[14 15] plus four distractor symptoms) was developed to assess knowledge across a broad range of physical, cognitive and emotional concussion signs and symptoms (CSS).[16] Items were scored on dichotomous yes (1) and no (0) scales, that were summed to form a total CSS knowledge score (ranging from 0 to 24), with higher scores indicating better knowledge.

Following a short hypothetical scenario featuring a player who received a heavy hit to the head during a game, respondents were asked to select which of eight signs or symptoms identified from the 2008 International Consensus Statement[7] they believed indicated concussion.

The remaining five items focused on knowledge of the correct management of a player with concussion from the time of injury to follow-up and return-to-play. The items were designed to reflect the AFL and NRL concussion guidelines available at the time of the survey.

Statistical analyses were performed using IBM SPSS V. 19. Given the non-symmetrical nature of the total score data, Mann-Whitney U tests were used to determine differences across the two football codes (AF and RL) and the two team roles (C+ST). When there were group differences, the Kruskal-Wallis test was used to determine which specific groups differed. Respondents who did not complete all items in a knowledge scale were removed from analyses involving that scale.

RESULTS

Of the 933 respondents, 260 were AF coaches, 161 were AF sports trainers, 267 were RL coaches and 228 were RL sports trainers. Seventeen respondents did not indicate both their sport and team roles and were excluded from further analyses. Although the overall response rate is low compared to the number of registered C+STs, the large number of completed surveys is sufficient to have high confidence in the precision of the estimated proportions presented below.

The overall GCK among each football personnel group is summarised in table 1. There was no significant difference in GCK between football codes (U=98 378, p=0.89), but there was across team roles (U=11 540, $p \leqslant 0.001$). Overall, sports trainers had higher GCK than did coaches (p=0.05), although this difference was only significant yet small within RL ($\chi^2_3=26.98$, p<0.001.)

Particular knowledge gaps and misconceptions were identified when individual GCK items were examined (table 2). For example, less than half of the coaches and sports trainers correctly recognised the increased risk of another concussion following an initial concussion. In addition, most C+STs incorrectly believed or were uncertain that scans typically show damage to the brain after a concussion occurs. Relatively few C+STs incorrectly believed that being knocked unconscious always causes permanent damage to the brain but almost a quarter were uncertain about this.

While the majority of C+STs correctly identified that concussion can sometimes lead to emotional problems, few strongly agreed. Almost one in five C+STs incorrectly believed that there are few long-term health and well-being risks from multiple concussions. A large proportion of C+STs incorrectly believed that wearing headgear can help prevent concussion. Less than one quarter of the C+STs correctly recognised that younger players typically take longer than adults to recover from concussion, and over 40% were uncertain about this. Finally, more than 44% of both C+STs incorrectly believed that players with a concussion can start normal training once they are symptom free.

There were no significant differences in concussion symptom knowledge (CSK) between football codes (U=86 963, p=0.81) or team roles (U=93 422.5, p=0.22) and the mean CSK score was 31.5 (95% CI 31.2–31.7, n=852) out of a possible 36. The proportion of respondents identifying each specific symptom of concussion is presented in figure 1. Over 90% of respondents correctly identified five of the eight key signs or symptoms of concussion. However, 38% (n=347) did not recognise 'the player's performance is worse than usual' as a possible feature of concussion. Similarly, 16% (n=146) failed to recognise 'the player isn't their usual self' as being indicative of concussion, with a further 17% (n=155) incorrectly identifying the distractor symptom of stomach pains as a feature of concussion.

There were no significant differences in CMK scores between the two football codes (U=95 182.5, p=0.96) or team roles

Table 1 General concussion knowledge score means and CI for each of the four football team roles

Team role and sport	n	General concussion knowledge score (max possible score=75) Median (IQR)
AFL coaches	257	55.0 (52.0, 58.0)
AFL sports trainers	160	56.0 (52.0, 60.0)
NRL coaches	262	53.0 (50.0, 56.0)
NRL sports trainers	224	55.0 (51.5, 58.5)

AFL, Australian Football League; GCK, general concussion knowledge; NRL, National Rugby League.

Table 2 Knowledge gaps identified in general concussion knowledge of coaches (n=519) and trainers (n=384) from community Australian Football and Rugby League

	Responses n (%)				
Statements	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
There is a higher risk of long-term problems if someone has a second concussion before recovering from the first one					
Coach	3 (0.6)	2 (0.4)	28 (5.4)	201 (38.7)	285 (54.9)
Trainer	2 (0.5)	2 (0.5)	6 (1.6)	134 (34.9)	240 (62.5)
People who have had one concussion are more likely to have another concussion					
Coach	11 (2.1)	125 (24.1)	150 (28.9)	179 (34.5)	54 (10.4)
Trainer	6 (1.6)	93 (24.2)	115 (29.9)	126 (32.8)	44 (11.5)
Symptoms of concussion can last for several weeks					
Coach	3 (0.6)	29 (5.6)	43 (8.3)	322 (62.0)	122 (23.5)
Trainer	8 (2.1)	11 (2.9)	20 (5.2)	235 (61.2)	110 (28.6)
Symptoms of concussion are usually gone after 10–14 days					
Coach	11 (2.1)	107 (20.6)	121 (23.3)	270 (52.0)	10 (1.9)
Trainer	7 (1.8)	84 (21.9)	83 (21.6)	200 (52.1)	10 (2.6)
Concussions can sometimes lead to emotional problems					
Coach	13 (2.5)	39 (7.5)	153 (29.5)	270 (52.0)	44 (8.5)
Trainer	6 (1.6)	26 (6.8)	79 (20.6)	222 (57.8)	51 (13.3)
Younger players (under the age of 18) typically take longer to recover from a concussion than adults					
Coach	8 (1.5)	152 (29.3)	268 (51.6)	79 (15.2)	12 (2.3)
Trainer	8 (2.1)	125 (32.6)	163 (42.4)	64 (16.7)	24 (6.3)
Players with a concussion should not be allowed to play until they have been assessed and cleared by a doctor					
Coach	10 (1.9)	17 (3.3)	20 (3.9)	181 (34.9)	291 (56.1)
Trainer	7 (1.8)	6 (1.6)	9 (2.3)	96 (25.0)	266 (69.3)
To be diagnosed with a concussion, you have to be knocked unconscious					
Coach	10 (1.9)	12 (2.3)	10 (1.9)	244 (47.0)	243 (46.8)
Trainer	12 (3.1)	5 (1.3)	5 (1.3)	162 (42.2)	200 (52.1)
A concussion can only occur if there is a direct hit to the head					
Coach	11 (2.1)	73 (14.1)	29 (5.6)	258 (49.7)	148 (28.5)
Trainer	11 (2.9)	40 (10.4)	17 (4.4)	184 (47.9)	132 (34.4)
	Responses n (%)				
Statement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Being knocked unconscious always causes permanent damage to the brain					
Coach	11 (2.1)	67 (12.9)	122 (23.5)	253 (48.7)	66 (12.7)
Trainer	10 (2.6)	38 (9.9)	84 (21.9)	199 (51.8)	53 (13.8)
After a concussion occurs, brain scans (eg, CT scan, MRI) typically show damage (eg, bruise, blood clot) to the brain					
Coach	22 (4.2)	187 (36.0)	192 (37.0)	109 (21.0)	9 (1.7)
Trainer	14 (3.6)	128 (33.3)	124 (32.3)	105 (27.3)	13 (3.4)
Elite football players are more likely to suffer a concussion than community level players					
Coach	9 (1.7)	23 (4.4)	21 (4.0)	239 (46.1)	227 (43.7)
Trainer	6 (1.6)	18 (4.7)	30 (7.8)	177 (46.1)	153 (39.8)
There are few risks to long-term health and well-being from multiple concussions					
Coach	20 (3.9)	69 (13.3)	43 (8.3)	209 (40.3)	178 (34.3)
Trainer	27 (7.0)	54 (14.1)	26 (6.8)	138 (35.9)	139 (36.2)
Wearing headgear can help to prevent a concussion					
Coach	51 (9.8)	222(42.8)	77 (14.8)	128 (24.7)	41 (7.9)
Trainer	27 (7.0)	133 (34.6)	68 (17.7)	100 (26.0)	56(14.6)
Players with a concussion can start normal training once they are symptoms free					
Coach	35 (6.7)	231 (44.5)	73 (14.1)	148 (28.5)	32 (6.2)
Trainer	20 (5.2)	148 (38.5)	41 (10.7)	128 (33.3)	47 (12.2)

Correct statements scores ranged from 1 (strongly disagree) to 5 (strongly agree) and higher scores reflected accurate knowledge. Incorrect statements scores were reverse coded.
GCK, general concussion knowledge.

(U=11 540, p=0.223), with a mean score of 11.7 of a possible 15 (95%CI11.6 to 11.8, n=862). The proportion of respondents selecting specific item responses is in tables 3–5.

Finally, while the majority of C+STs (70%) correctly identified 'they remain symptom free throughout their rehabilitation' as the most important factor during a player's rehabilitation following a concussion, only 25% of participants chose 'they avoid contact training drills until the very end of their rehabilitation'.

DISCUSSION

This study, the first to assess concussion knowledge in community sport in Australia, involved two popular sports with a

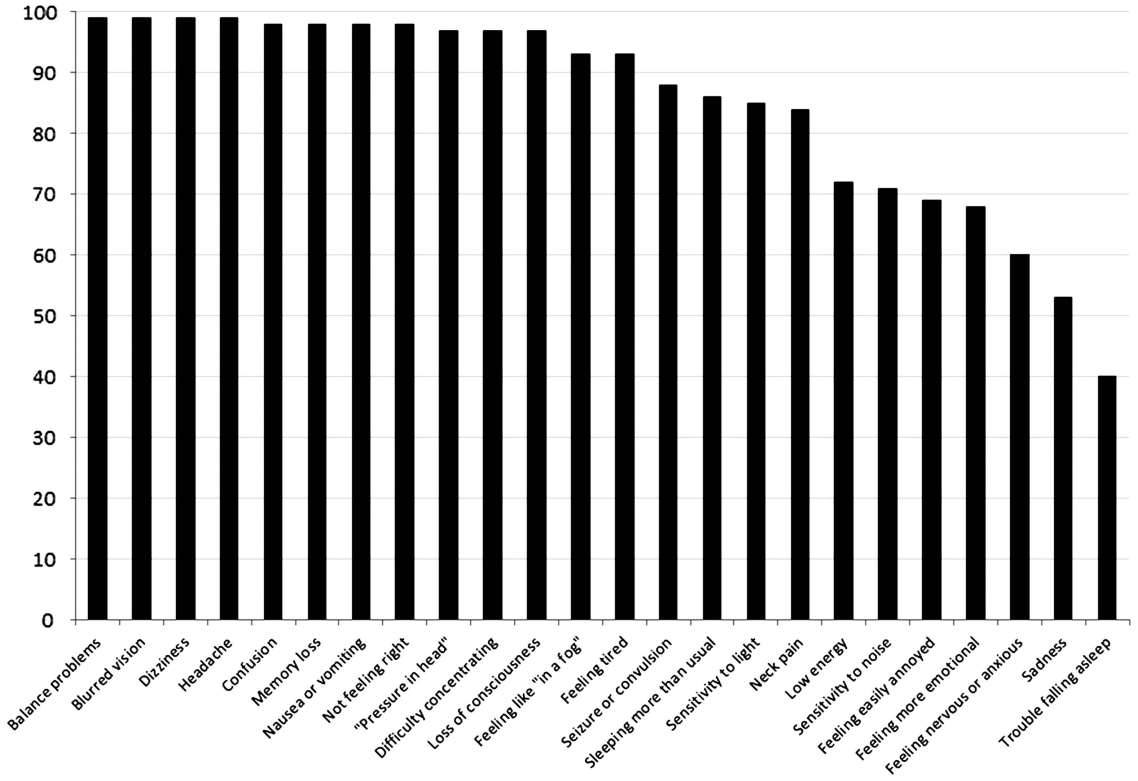

Figure 1 Percentage of Australian Football and Rugby League coaches and sports trainers who correctly identified symptoms of concussion (n=916).

considerable risk of concussive injury.[3] The results demonstrated that surveyed AF and RL C+STs had relatively good general knowledge about concussion, which is consistent with findings from other sporting contexts.[10 12] There was no difference across the two football codes, but STs displayed a small but significantly better knowledge than coaches, particularly in RL. The differences between C+STs is not surprising given that the STs' major role is to recognise and manage sports injuries, while the coaches' main role is to govern play and training activities.[17] It could also possibly be explained by better education of coaches in AF, compared to RL.

For all other survey components, there were no differences between team roles, possibly reflecting the existing high level of coach education in the two football codes studied. Approximately one–quarter of both C+STs failed to recognise the increased risk of another concussion following an initial concussion. This is consistent with findings in Italian soccer coaches,[8] but inconsistent with a study of Canadian minor hockey coaches.[11] This suggests that further efforts are needed to properly educate C+STs about concussion risk and the rationale for strict return-to-play protocols.

Concussion usually results in functional disturbances rather than structural injury to the brain so standard structural neuroimaging typically does not detect postconcussion brain abnormalities.[7] However, a significant proportion of C+STs incorrectly believed that postconcussion brain scans show damage to the brain, consistent with a previous study of Canadian minor hockey coaches.[11] Further, more than a third of respondents believed or were uncertain about whether being knocked unconscious always causes permanent damage to the brain, consistent with other New Zealand studies.[18 19] Combined, these results suggest that C+STs have misconceptions about the impact that concussion has on the structure of the brain. Such beliefs might detract from the importance that C+STs place on proper concussion management, especially if they believe that 'the damage is already done'. It will be

Table 3 Coach and sports trainer responses to: 'Which of the following factors are important to consider when deciding whether to take a player off the ground following a hit to the head?' (n=882)

Important factor	Yes, n (% of respondents)	No, n (% of respondents)
Presence/absence of concussion symptoms	872 (98.9)	10 (1.1)
The player's history of concussion	783 (88.8)	99 (11.2)
The player's general fitness	214 (24.3)	668 (75.7)
Whether or not the player wants to come off	98 (11.1)	784 (88.9)
How much time there is before the end of the half	14 (1.6)	868 (98.4)
How 'tough' the player is	14 (1.6)	868 (98.4)
The player's importance to the team's performance	9 (1.0)	873 (99.0)

Table 4 Coach and sports trainer responses to: 'Under which of the following circumstances would it be appropriate for a player to return to play *on the day* they suffer a concussion?'

Circumstance	Appropriate, n (% of respondents)	Not appropriate, n (% of respondents)
The doctor says the player is ready to play (n=883)	758 (85.8)	125 (14.2)
The player no longer shows any signs or symptoms of concussion (n=869)	165 (19.0)	704 (81.0)
The sports trainer says the player is ready to play (n=869)	123 (14.2)	746 (85.8)
The physiotherapist says the player is ready to play (n=868)	70 (8.1)	798 (91.9)
The player says they are symptom free and ready to play (n=866)	23 (2.7)	843 (97.3)

important to strengthen messages that all concussed players should undergo adequate recovery.

A relatively small proportion of both C+STs correctly recognised that younger players typically take longer to recover from concussion than adults, with most indicating that they were uncertain about this. This knowledge gap may reflect limited involvement with younger players. Moreover, at the time of this study, the AFL and NRL guidelines referred to the management of adults. As now recognised in the 2012 International Consensus Statement on Concussion in Sport, the management of children requires specific guidelines, and understanding the differences between adult and childhood concussion management is paramount for messages aimed at the community level.[2]

There was also uncertainty and misconception about the long-term impact of concussion on player health and well-being. A lack of understanding of potential long-term complications of concussion may lead to inadequate management and premature return to play. It is critical that C+STs receive adequate and up-to-date education regarding the potential impact of concussion on a player's long-term health and emotional well-being.

One of the most common misconceptions held by respondents, particularly coaches, was that wearing headgear can prevent concussion. This misconception is frequently reported[4 11] despite there being no substantial evidence that headgear will prevent or reduce concussion.[7 20] This misconception should be redressed as a priority since well-intentioned efforts by C+STs could misdirect community club resources for very little gain. Moreover, C+STs need to have a clearer understanding of this issue to present a confident, informed response to pressure from parents or other members of the community, to mandate helmet use.

Finally, there is a misconception among the majority of coaches and a significant proportion of STs that players can return to normal training once they are symptom free. Although remaining symptom free is a crucial component of the AFL and NRL return-to-play guidelines, the guidelines also stipulate that players should return-to-play gradually, using a stepwise approach. As coaches have a major role in ensuring this, their lack of understanding about this key tenet is concerning.

On a positive note, the once common misconception[9] that a concussion can only occur with a loss of consciousness appears to have been dispelled. This finding is supported by recent studies involving other sports.[8 11]

Coaches and sports trainers generally had a good knowledge of concussion signs and symptoms, in contrast to Italian soccer coaches.[8] A large majority identified the cognitive signs and symptoms such as memory loss and confusion, and were aware of most of the physical symptoms such as blurred vision and headache. However, fewer identified low energy and sensitivity to noise as physical symptoms of concussion. Consistent with another study of coaches,[9] 'trouble falling asleep' was the most under-recognised, which is not surprising given that it is not an acute symptom of concussion. Fewer respondents identified the emotional signs and symptoms of concussion, compared to the

Table 5 Coach and sports trainer responses to concussion management scenarios (n=882)

Circumstance	Responses, n (% of respondents)
A player who has a concussion should be referred to a medical doctor…'	
As soon as possible, regardless of symptoms	549 (62.2)
If they lost consciousness, even if only for a moment	171 (19.4)
If their symptoms have not improved within an hour	89 (10.1)
If they still have symptoms the following day	39 (4.4)
If they were unable to return to play on the day	34 (3.9)
Who should determine when a player who has a concussion can be return to play?	
A doctor	839 (95.1)
A physiotherapist	1 (0.1)
The sports trainer	37 (4.2)
The coach	3 (0.3)
The player	2 (0.2)
'The most important factor during a player's rehabilitation following a concussion is that…'	
They remain symptom free throughout their rehabilitation	642 (72.8)
They maintain a close bond with their teammates	5 (0.6)
Their base fitness is maintained through aerobic activity such as swimming	5 (0.6)
They avoid contact training drills until the very end of their rehabilitation	227 (25.7)
Resistance training is incorporated into their rehabilitation	3 (0.3)

other symptom groups perhaps reflecting the more subtle and ambiguous nature, less frequent reporting, delayed onset and the high prevalence of these symptoms in the general community. It would seem sensible to educate C+STs on recognising the emotional signs and symptoms of concussion, particularly since players may not voluntarily report such symptoms themselves.

The AFL and NRL concussion guidelines clearly stated that any player who has suffered a concussion should not be allowed to return-to-play in the same game. The guidelines also warn against being swayed by the opinion of the player, trainers, coaching staff or others suggesting premature return-to-play. Nearly one-fifth of all respondents indicated that it would be appropriate for a player to return-to-play on the day they suffer a concussion if they no longer show any signs or symptoms of concussion. It seems that the 'no return-to-play on same day' message has not yet fully reached the target audience. Importantly, the majority of C+STs indicated that they thought that it would be appropriate for a player to return-to-play on the same day they suffer a concussion if the doctor says they are ready to play. This finding highlights the important role GPs and club doctors play in the management of concussion and the influence they can have over return-to-play decisions. Importantly, it also emphasises why general practitioners (GPs) need to be educated about 'best practice' concussion management.

According to the AFL and NRL concussion guidelines, all players with concussion or a suspected concussion need an urgent medical assessment (with a registered medical doctor). More than a third of respondents failed to recognise that a player who has a suspected concussion should be referred to a medical doctor 'as soon as possible, regardless of symptoms'. Approximately one-fifth suggested that players with a concussion should be referred to a medical doctor if they lost consciousness, even if only for a moment, and 10% indicated that players should be referred to a doctor if their symptoms have not improved within an hour. This highlights the need to renew efforts to reinforce the message that all players with a concussion should be assessed by a medical doctor.

Finally, while the majority of C+ST correctly identified that the most important factor during a player's rehabilitation following a concussion is that they remain symptom free, a quarter of respondents indicated that avoiding contact training drills until the very end of their rehabilitation was the most important factor. While this response reflects some understanding of the gradual, stepwise approach to return-to-play recommended in the AFL and NRL concussion guidelines, it suggests that they do not understand the underlying purpose of the stepwise approach. It would be valuable to clarify to C+STs that it is recommended that players return-to-play gradually and that contact drills are postponed until the end to ensure that players remain symptom free throughout their recovery and to make it easier to return them to a non-symptomatic state if their symptoms were to recur.

There are some limitations associated with this study. Invitation to participate in the survey was distributed widely but it is not known how representative of all target group members the final set of survey responses are. The large sample size however helps to minimise potential responder bias. On the other hand, the statistical significance of some of the apparently small differences between C+STs was quite substantial and this probably reflects the relative large sample size.

As a self-report survey, the views expressed by the respondents could not be validated. The survey did not collect information about prior awareness or use of sport-specific guidelines. As such, it was not possible to determine whether these guidelines have been useful in potentially increasing knowledge about how to recognise/manage concussion.

In summary, this paper describes the current concussion knowledge of AF and RL C+STs in relation to messages contained in the previously disseminated concussion management guidelines by the two sports governing bodies. The identified gaps in knowledge and misconceptions should be addressed to enable C+STs to manage players with a concussion more appropriately.

What are the new findings?

- There is inadequate knowledge of concussion guidelines in Australian community sport.
- Those responsible for the care of athletes in community sport have some understanding of concussion, but are not adequately familiar with the management of concussion.
- There is a greater gap in knowledge of how to manage concussion in children and adolescents.

How might it impact on clinical practice in the near future?

- Inadequate management of concussion may impact on the short-term and long-term health of the athlete's brain.
- The results from this study should motivate the sporting community to develop appropriate concussion education programmes.
- Education programmes need to focus on concussion management and be specifically targeted to care for athletes in community sports.

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Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data is not available, but a copy of the survey can be provided upon request.

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