



Original research

Concussion assessment and management – What do community-level cricket participants know?

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ABSTRACT

Objectives: To explore Australian cricket participants' knowledge of concussion assessment and management, and awareness of current concussion guidelines.

Design: Cross-sectional survey.

Methods: Novel and validated surveys were disseminated online, among over 16 year Australian cricket players and officials at the end of the 2018/19 cricket season. Data were collected on knowledge and awareness of concussion and analysed using descriptive statistics and crosstabulations. Further comparisons were made for the players between injured and non-injured, and helmet wearers and non-helmet wearers using Fisher's exact statistical test.

Results: Both players ($n = 224$, 93 %) and officials ($n = 36$, 100 %) demonstrated strong knowledge of the importance of immediately evaluating suspected concussions. In comparison with players without helmets ($n = 11$), those using helmets ($n = 135$) considered replacing their helmets after a concussion to be vital to concussion assessment ($p = 0.02$). Overall, 80–97 % of players and 81–97 % of officials understood the importance of many factors regarding concussion management. When concussion management knowledge was compared by injury status, injured players ($n = 17$, 94 %) believed someone with a concussion should be hospitalised immediately, in contrast to non-injured players ($n = 154$, 69 %) ($p = 0.04$). Players (63 %) were less aware of concussion guidelines than officials (81 %).

Conclusions: Overall, the knowledge of concussion assessment and management was satisfactory. However, there were discrepancies among players on some aspects of awareness of concussion guidelines. Increasing players' familiarity and experience in using the concussion guidelines is warranted. Targeted campaigns are needed to further improve concussion recognition and treatment at community-level cricket, so all participants play a role in making cricket a safe sport.

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Practical implications

- Despite the lack of access to qualified medical personnel at the community-level, a high percentage of survey participants demonstrated satisfactory levels of knowledge regarding concussion management, which indicates serious complications from cricket-related concussions could be minimised.
- It is encouraging that survey participants perceive the importance of obtaining medical clearance following a concussion, suggesting that cricket participants will seek medical attention sooner rather than later.

- As the survey participants demonstrated increased awareness of concussion guidelines, they are likely to choose and wear helmets that meet recommended safety standards, reducing the risk of catastrophic HNF injuries in the future.

1. Introduction

A concussion is a form of traumatic brain injury caused by sudden impact to the body or head, leading to a range of neurological symptoms, which may affect a person's cognitive abilities, physical sensations, and emotional state.¹ Short-term neurological impairments may resolve spontaneously after a concussion, but long-term complications may persist, and therefore, prompt identification and management is vital.¹ Within Australia, there are overarching guidelines for concussion

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management in sport and anyone with a suspected concussion should immediately cease playing sports and be evaluated by a medical professional.² Additionally, any participant with a suspected or confirmed concussion is advised to refrain from participating in sports for the following 48 h, rest physically and mentally, and seek medical clearance before returning to sport.²

The incidence of concussion in contact sports is high, especially rugby union (4.2/1000 players) and ice hockey (1.2/1000 players).³ Concussion in contact sports is often serious in nature, requiring prolonged recovery periods.^{3–5} In 2016, experts in sport-related concussion established a consensus statement on assessment and management of concussion.¹ These guidelines outline game, post-game and return-to-play concussion management strategies to ensure participants with a suspected concussion are treated appropriately.¹ However, recent studies have highlighted deficiencies in the knowledge, attitudes and behaviours of both athletes and officials regarding concussion recognition, reporting and proper return-to-play procedures.^{6,7} Officials were unaware that young athletes might need more time to recover from concussions than adults, and players who did not access medical personnel were less knowledgeable about concussions.^{6,7} However, the reason for the knowledge gap in the major sporting codes is unclear. As for accessibility to medical treatment, most levels of Australian football and rugby league employ sports trainers to provide first-aid and acute injury management during games and training sessions.⁸ Nonetheless, qualified medical personnel at community-level cricket have often been inaccessible due to practical and financial barriers.⁹

In cricket, a concussion is the most common head, neck, and facial (HNF) injury, usually resulting from a ball hitting various parts of the helmet shell as well as more posteriorly at the back of the neck.^{10,11} A literature review in 2016 described five HNF injury related deaths in professional cricket.¹⁰ From inception of the sport to 2016, 28 cricket-related deaths were reported in Australia, all as a result of a blow to the head or neck by a ball.¹² Recently, a tragic incident that resulted in the sudden death of a test cricketer instigated the need for more research on helmet design and safety policies and procedures to reduce catastrophic HNF injuries in the sport.¹⁰

Following the Berlin consensus on sports-related concussion in 2016 the International Cricket Council (ICC), England and Wales Cricket Board (ECB) and Cricket Australia (CA) officially implemented concussion guidelines in September 2017.¹³ As a result of recent updates, including the adoption of helmets, the associated risk of a ball impact to the head has decreased, and the use of standardised concussion assessment tools and neurocognitive testing batteries has enabled standardisation of both acute assessment and return to play of injured players.¹⁴ However, these guidelines are best suited at the elite-level of the game and a more targeted and tailored approach is required within the community-level to ensure consistency in concussion recognition, reporting and management at all levels of play. Although there is extensive research on the knowledge, attitudes, and behaviours towards concussions of athletes and coaches in contact sports,^{6,7,15} there is limited research examining the knowledge of concussion assessment and management among cricket participants, including their awareness of concussion guidelines.¹⁴ Hence, this study aimed to determine the knowledge and awareness of current concussion guidelines, including assessment and management of concussion among Australian community-level cricket participants.

2. Methods

Surveys for this study were developed using several resources related to concussion in sports^{17–19} and based on the Theory of Planned Behaviour (TPB) model.²⁰ The TPB was chosen over other behavioural and social science theories and models due to its previous application in sports injury research.²¹ The questions related to concussion were designed based on the constructs of the TPB, specifically focused on subjective norms, which is one of the four main components of the theory, along with attitudes, perceived behavioural control, and behavioural

intention.²⁰ Subjective norms refer to the influence of social factors on decision-making and behaviour. The items on concussion knowledge were mainly adapted from the Australian Football Injury Prevention Program,²² and items on awareness of concussion guidelines were constructed from Cricket Australia's Concussion and Head Trauma Policy.¹³ These sources represent stakeholders who exert social influence in shaping understanding of concussion knowledge. Due to the nature of their involvement, separate surveys were constructed for players and officials. To improve consistency of responses and expedient analysis, the surveys comprised of closed-ended questions. Each question had a limited number of response options to reduce completion time and achieve a high response rate. The surveys consisted of separate sections for research study details and consent, personal information, HNF injuries, helmet use information, and knowledge and awareness of concussion. This paper presents only the findings of the final section that contained three questions on the knowledge and awareness of concussion. The question on knowledge of concussion assessment (nine items), and knowledge of concussion management (six items) consisted of a three-point Likert scale ("agree", "undecided", "disagree"). The question on the awareness of concussion guidelines (eight items) was dichotomous ("yes", "no").

A panel of five experts, including a clinical psychologist, statistician, and three cricket injury professionals with expertise in concussion behaviours, assessment, and management, rated each survey item on a three-point scale ranging from not necessary to essential during the content validation process. Questions that were deemed unnecessary were removed and certain statements were merged with questions that were more closely related to their content. Subsequently, face validation was conducted using five players from different age groups and two officials, all aged 16 years or older, to ensure that the questions were relevant, reasonable, unambiguous, and clear. Finally, a test/retest reliability measured the consistency of results and a Cohen's kappa coefficient (K) was calculated, with the same surveys repeated within a week on the same sample of 25 Victorian club cricket participants, aged 16 or older. A weighted kappa ($Kw2$) statistic was used for ordinal questions (with Likert scale responses). Initial surveys with a five-point Likert scale produced low weighted kappa values (0.16 to 1). Therefore, it was decided to reduce the responses to a three-point Likert scale for the final versions, which improved the weighted kappa values (0.65 to 1), demonstrating a strong reliability.

Any player or official aged 16 or older, who had participated at any level of cricket in Australia during the 2018–19 season was invited to complete the surveys. The cut-off age of 16 years was set to ensure that participants could give their own consent for the self-administered surveys. For this study, 3622 cricket clubs in Australia with 444,570 players, 7099 active umpires and 46,493 accredited coaches at community cricket were considered, with the anticipation at least 200,000 or more players and 50,000 officials meeting our eligibility criteria. At least 40,000 Australian cricket participants were targeted with the expectation of a 4:1 (players:officials) participation. A priori power analysis using GPower (V.3.1.9.4) was used to determine the necessary sample size of 235 players and 59 officials ($n = 294$). To reduce recall bias, this study was conducted at the end of the 2018/19 cricket season, with a six-month recall period.²³ Given the large size of the target population and demographics, an online survey was determined as the best method of distribution.

From November 2018 to April 2019, data was primarily collected via a link posted on the Cricket Australia Twitter page, Facebook, and posters with a Quick Response (QR) code which was displayed in cricket clubs. The survey links allowed only one survey per web address. Institutional Human Research Ethics Committee granted ethics approval (A18-148). Data were exported into the Statistical Package for the Social Sciences (SPSS®) 21.0 (IBM SPSS Inc., Somers, NY, USA). The Kolmogorov–Smirnov and Shapiro–Wilk tests were used to determine the normality of the data. A large proportion of the data was not normally distributed, so Mann–Whitney and Kruskal–Wallis tests were used to determine any statistically significant differences between groups.

Table 1
Comparison of the two groups for agreement regarding concussion assessment.

Factor	Players				Officials				N	p-Value ^a
	Factor agreement				Factor agreement					
	Agree %	Undecided %	Disagree %	n	Agree %	Undecided %	Disagree %	n		
Be removed from the field to be assessed by qualified medical personnel	77	14	9	241	89	5	6	36	277	0.29
Be assessed immediately	93	5	2	241	100	0	0	36	277	0.45
Be assessed if they fall to ground	89	4	7	241	94	6	0	36	277	0.16
Be assessed if they have symptoms of concussion	96	1	3	241	100	0	0	36	277	0.74
Continue to play and be assessed at the end of the over[^]	4	10	86	241	14	3	83	36	277	0.04
Continue to play and be assessed at the next break in play	4	7	89	241	8	6	86	36	277	0.52
Continue to play and be assessed at the end of the day	5	5.0	90	241	8	6	86	36	277	0.54
Continue to play and be assessed if they develop symptoms	14	12	74	241	11	11	78	36	277	0.95
Have their helmet replaced	61	28	11	241	72	17	11	36	277	0.35

^a Fisher's exact test.[^] Statistically significant result.

Descriptive statistics were used to explore the knowledge of concussion assessment, management, and awareness of concussion guidelines. Fisher's exact statistical test was used to compare any statistically significant association between independent groups among the two cohorts ("injured" vs "non-injured", "helmet users" vs "non-helmet users") and to make comparisons between "players" vs "officials". Due to the small sample size and the fact that more than 20 % of cells produced frequencies < 5, Fisher's exact test was preferred over the chi-squared test.²⁴

3. Results

A total of 375 surveys (326 players, 49 officials) were received of which 98 were incomplete. For the final analysis 241 players' (213 male, 28 female) and 36 officials' (29 male, 7 female) surveys were included. The participant age ranged from 16 to 65+ years, with most responses coming from players in the 18–34 age group and officials in the 25–54 age group. The majority of players (68%, n = 187) were from the club level, whilst officials represented all levels of play. Regarding the playing position of the player survey respondents, 122 (44 %) were all-rounders, followed by 74 (27 %) batters, 53 (19 %) bowlers, and 26 (10 %) wicketkeepers. Most of the official survey responses were from 19 (50 %) coaches and 6 (16 %) physiotherapists, with the remaining responses provided by umpires, managers and other officials. With regard to the extent of helmet use, a total of 218 (90 %) players and 22 (61 %) officials reported wearing a helmet during the 2018/19 cricket season. A total of 22 (9 %) players and 3 (8 %) officials reported HNF injuries for the 2018/19 season. Among those who sustained injuries, 21 players (9 %) and 2 (6 %) officials sustained HNF injuries despite using helmets. In terms of knowledge of concussion assessment, a high proportion of both players (n = 224, 93 %) and officials (n = 36, 100 %) perceived the importance of the immediate assessment of a suspected concussion (Table 1). In comparison to the officials (n = 5, 14 %), a significantly lower percentage of players (n = 10, 4 %) perceived that a

participant with a suspected concussion could be allowed to continue play and be assessed at the end of the over (p = 0.04) (Table 1).

For further comparisons on players' knowledge of concussion assessment by HNF injury status, there were no significant differences between the injured and non-injured players (p ≥ 0.14). Helmet users among the players (n = 135, 62 %) perceived that replacing their helmets after an impact was important compared to non-helmet users (n = 11, 48 %) (p = 0.02). In comparison to the non-helmet users (n = 6, 26 %), a significantly lower percentage of helmet users (n = 28, 13 %) in the player cohort agreed on allowing participants with a suspected concussion to continue playing and be evaluated only if symptoms developed (p = 0.02).

Most of the survey participants possessed a sound understanding of the importance of multiple factors on concussion management with the player cohort ranging from 70 to 89 % and officials from 81 to 97 % (Table 2). Based on comparisons between the two cohorts, the only statistically significant difference was in perception of the importance of substituting (p = 0.03), with officials (n = 35, 97 %) perceiving substitution more important than players did (n = 195, 81 %) (Table 2).

Comparisons of knowledge of concussion management among players by HNF injury status produced statistically significant results, with a large percentage of the injured players (n = 17, 94 %) perceiving the importance of someone with a confirmed concussion to be sent to hospital immediately (p = 0.04) in comparison to the non-injured (n = 154, 69 %). For the knowledge of concussion management among players by helmet use status there were no significant findings (p ≥ 0.07).

Officials (n = 29, 81 %) demonstrated greater awareness of the concussion guidelines in cricket (p = 0.04) in comparison to players (n = 152, 63 %) (Table 3). A greater percentage of officials (n = 28, 78 %) had read about the concussion guidelines, in comparison to the players (n = 111, 46 %) (p < 0.01). The official cohort (n = 24, 67 %) also demonstrated greater awareness of concussion/head injury testing apps (p < 0.01) as opposed to the player cohort (n = 92, 38 %) (Table 3). Officials

Table 2
Comparison of the two groups for agreement regarding concussion management.

Factor	Players				Officials				N	p-Value ^a
	Factor agreement				Factor agreement					
	Agree %	Undecided %	Disagree %	n	Agree %	Undecided %	Disagree %	n		
Be sent to hospital immediately	70	20	10	241	81	14	5	36	277	0.58
NOT to be allowed to drive that day	85	10	5	241	92	3	5	36	277	0.32
NOT to be allowed to sleep continuously that night	37	48	15	241	33	61	6	36	277	0.24
NOT to be allowed to train or play until cleared by a doctor	89	8	3	241	89	8	3	36	277	0.90
NOT to be allowed to return to play that day, but can train or play the next day	23	34	43	241	22	50	28	36	277	0.16
Be allowed a substitute player/official[^]	81	11	8	241	97	0	3	36	277	0.03

^a Fisher's exact test.[^] Statistically significant result.

Table 3
Comparison of the two groups for awareness of concussion guidelines.

Factor	Players			Officials			N	p-Value ^a
	Factor awareness			Factor awareness				
	Yes %	No %	n	Yes %	No %	n		
Awareness of the concussion guidelines in cricket[^]	63	37	241	81	19	36	277	0.04
Awareness of the concussion guidelines in other sports	60	40	241	64	36	36	277	0.72
I have read about concussion guidelines in cricket[^]	46	54	241	78	22	36	277	<0.01
Awareness of my club access to CA concussion guidelines	70	30	241	81	19	36	277	0.24
Awareness on international standard for helmet recommended by CA	93	7	241	100	0	36	277	0.14
Awareness that helmet use is made compulsory by CA	80	20	241	75	25	36	277	0.51
Awareness of concussion/head injury testing apps[^]	38	62	241	67	33	36	277	<0.01
Awareness that cricket helmets should comply with British standards[^]	64	36	241	86	14	36	277	<0.01

^a Fisher's exact test.

[^] Statistically significant result.

(n = 31, 86 %) were largely aware that cricket helmets should comply with British standards (p = 0.01) compared to the players (n = 154, 64 %). A large proportion of players (n = 224, 93 %) and officials (n = 36, 100 %) were aware of the international standard for helmets recommended by Cricket Australia (Table 3).

Analysis of the players' awareness of concussion guidelines by HNF injury status did not produce any statistically significant results (p ≥ 0.21). Comparisons among the players by helmet use status revealed a significant result (p = 0.01), with a high percentage of players (n = 179, 82 %) who wore helmets during the 2018/19 cricket season being aware that helmet use is mandatory by Cricket Australia compared to those who did not use helmets (n = 13, 57 %).

4. Discussion

This is the first study to explore the current knowledge and awareness of concussion among cricket participants. As per the findings of this study, players and officials displayed a satisfactory level of knowledge in concussion assessment and management. However, in contrast to officials, the player cohort in this study was less aware of concussion guidelines, concussion testing tools, and recommended helmet standards. The current study suggests that continuing education and research are essential to protect cricket participants from HNF injuries and to ensure that concussions are identified, reported, and managed properly.

A multifaceted approach is recommended in international guidelines on concussion assessment and management, and it is crucial that sport participants understand concussions in order to achieve this goal.¹ In the past, the lack of knowledge about concussions in the sporting community has resulted in inadequate treatment of concussion symptoms, increasing the risk of serious injury.¹⁶ Nevertheless, research in the fields of cycling, equestrianism, surfing, and snow sports indicates that athletes are exhibiting positive outcomes in their understanding and attitudes towards concussions.^{25–27} Players who wore helmets in our study were more knowledgeable about concussion assessment, especially regarding the importance of helmet replacement following an impact. In light of the fact that Cricket Australia (CA) has clearly defined guidelines for helmet replacement following an impact, this finding is very encouraging.¹³ According to our study participants, concussion management knowledge was high, which indicates that serious complications from cricket-related concussions could be minimised. Moreover, players and officials perceived that a participant who has suffered a concussion must be cleared by a doctor before returning to training or playing. According to this finding, cricket participants who perceive the significance of seeking medical attention are more inclined to seek it after experiencing a concussion than those who do not perceive its significance. However, access to medical staff trained in contemporary care can be difficult at community cricket, which could result in concussions not being managed appropriately.⁹ Many cricket clubs lack the financial and practical resources to hire sports trainers who are trained in concussion management, whilst these services are routinely available to

Australian football and rugby league at community-level.⁸ Therefore, it is important that any cricket officials, including team coaches, managers and even umpires, are sufficiently trained to recognise and to take appropriate measures to assess and manage any HNF injury. Through accreditation and continuing education programmes designed for officials that include concussion education, this can also be extended to players. Additionally, easily accessible print and electronic materials developed by stakeholders can be used to provide concussion education to cricket participants.^{13,28}

With an increased awareness of sport-related concussion in recent years, there has been an increased concern for the athlete's wellbeing both immediately and in the longer term, following a concussion.²⁹ In elite-level cricket, concussion guidelines, helmet standards, and concussion substitutes have contributed to timely assessment and management of concussion and HNF injury.^{13,29} Our study was the first to assess the awareness of concussion guidelines and concussion assessment tools among community cricket participants. In general, officials from our study were more aware of concussion guidelines than players, indicating a knowledge gap among players at the grassroots level. Whilst the officials are understood to possess more knowledge than players, a study that involved school rugby players has confirmed that players generally gain knowledge about identifying and reporting concussions from their coaches or other officials, highlighting the active role of coaches/officials in educating players on this matter.³⁰ The reduction of this knowledge gap could, however, increase the likelihood of players recognising and reporting concussion, thereby minimising serious injuries. Considering the findings of our study, it is possible that the players were undereducated due to a lack of knowledge dissemination from the officials.³¹ In view of this, introducing strategies to disseminate information regarding concussion recognition and management to players via officials could potentially result in a reduction in serious HNF cricket injuries.

In order to minimise serious HNF injuries, Cricket Australia (CA) has recommended helmet safety standards¹³ and our results indicate that these standards were well known among survey participants. Additionally, a high percentage of our players who wore helmets were aware that CA had made helmet use mandatory. There is a strong possibility that increased awareness will lead to participants choosing and wearing helmets that comply with the recommended safety standards, thus reducing the risk of catastrophic HNF injuries in the future. To promote awareness of concussion guidelines among cricket participants the ICC has introduced a concussion action plan.²⁸ There are also other freely accessible electronic and print tools and applications such as Sports Concussion Assessment Tool (SCAT).^{13,28} Increasingly, the internet is being used as an educational tool in concussion, with online courses and websites being the most popular options.³⁰ However, our findings indicate a gross lack of awareness of concussion assessment tools among players in comparison to the officials. A lack of education and exposure to easily accessibility concussion assessment tools may have contributed to players not being aware of these free resources. This

issue can be effectively addressed by designing user-friendly, regularly updated, and administratively convenient online learning programmes. Additionally, freely accessible mobile applications can be introduced to provide education as well as tools to aid in immediate diagnosis and effective management of concussion.

5. Limitations

Our results are largely reflective of participants from the state of Victoria with a relatively smaller number of officials in comparison to the player cohort. There is a possibility of response bias due to our findings largely coming from the state of Victoria. However, Victoria has one of the highest rates of annual participation in cricket, thus our findings provide sufficient information in understanding the knowledge and awareness of concussion among Australian cricket participants. This study was limited by the absence of frequency-based injury and helmet-use data, which hindered the determination of injury frequency based on helmet usage during incidents. This limits our ability to fully understand the pattern of injuries in the population we studied and may impact the generalisability of our findings. Finally, this study was not designed to explore participants' knowledge of concussion symptoms, but future studies will be required to investigate this as symptom recognition would result in a more accurate diagnosis, especially in the absence of qualified medical personnel.

6. Conclusion

In summary, findings of this survey revealed satisfactory levels of knowledge and awareness of concussion among Australian cricket participants. Despite positive results, some areas of concern remain, including a lack of knowledge regarding concussion assessment and management among non-injured players who were not wearing helmets in the 2018/19 cricket season. Comparatively, officials were more aware of concussion guidelines. Concussion assessment and management will be improved through better knowledge and awareness. Moreover, increasing participants' knowledge and awareness of concussion will ensure safety and reduce the risk of serious HNF injuries. Individualised targeted educational interventions could be developed by examining further the factors associated with poor knowledge and attitudes among cricket participants. Educating participants about concussions using a more reflective approach can help them integrate theoretical knowledge and its practical applications. Concussion education is a crucial first step, but beyond knowledge, further research is required to investigate other factors contributing to prevention, recognition, and management of concussion in cricket.

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Confirmation of ethical compliance

This study was approved by the Federation University Australia's Human Research Ethics Committee under the protocol ID, A18-148 "A survey on head, neck and facial related injuries among community cricket participants including coaches, support staff and umpires in Australia".

CRedit authorship contribution statement

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- Conceptualisation
- Methodology
- Formal analysis
- Investigation

- Data curation
- Writing - Original draft & editing
- Visualisation
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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- Conceptualisation
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Declaration of interest statement

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