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New Zealand Secondary School Students' Knowledge, Attitude and Behaviours Towards Sports-Related Concussion

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ABSTRACT

Sports-related concussion is a significant problem in New Zealand, with an estimated 21% of all traumatic brain injuries occurring in the sporting environment. The symptoms of sports-related concussion experienced by high school-aged athletes are often associated with a decline in academic performance, and are commonly more severe and persistent then those experienced by adult athletes. A 35-item, multi-choice questionnaire was used to ascertain New Zealand secondary school students' knowledge, attitudes, and behaviours of sports-related concussion. By comparing results from 2018 to those obtained in 2017, this study investigated the impact that a 2018 Accident Compensation Corporation (ACC) social media campaign may have had on New Zealand secondary school students' knowledge, attitudes, and behaviours regarding sports-related concussion. The main findings of this study show that the ACC social media campaign did not alter students' knowledge, attitudes, and behaviours toward sports-related concussion. Students were knowledgeable regarding concussion and showed positive attitudes towards correct management of the injury. Students had specific knowledge gaps regarding the onset of symptoms, activities to avoid post-concussion, the possible complications of multiple injuries, and recognition of the less discernible symptoms of concussion. These results suggest that secondary school students would benefit from further education on the possible long-term effects of sports-related concussion and the importance of effective management once a concussion has occurred.

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INTRODUCTION

The Concussion in Sport Group consensus statement defines sports-related concussion (SRC) as a traumatic brain injury induced by biomechanical forces (McCrory et al., 2017). Concussion can be caused by a direct blow to the head or may result from forces transmitted to the head from a blow elsewhere on the body. A typical concussion is characterised by the rapid onset of short-lived neurological impairments that resolve spontaneously, although in some cases, the onset of signs and symptoms can be delayed or the symptoms may fail to resolve (McCrory et al., 2017). In New Zealand, SRC is a significant problem, with an estimated 21% of all traumatic brain injuries occurring in the sporting environment (Theadom et al., 2014). Individuals who sustain SRC may experience somatic or physical symptoms, such as headache, dizziness, or poor balance; cognitive difficulties, such as impaired concentration or memory loss; and sleep disturbance or altered mood (Wasserman et al., 2016). When compared to older athletes, the symptoms experienced by high school-aged athletes are often more severe and persistent (Williams et al., 2015), and are associated with a decline in academic performance (Wasserman et al., 2016).

There are currently no clinical tests that offer an immediate and reliable concussion diagnosis. Therefore, diagnosis relies on the interpretation of self-reported symptoms. However, as the majority of concussions occur without a loss of consciousness or clear neurological signs (McCrory et al., 2017), and the signs and symptoms of concussion are vague, not specific to concussion, and can occur in people without injury (Anderson et al., 2016), SRC is notoriously difficult to diagnose. Due to the confusion around the signs and symptoms of concussion, with many individuals believing there must be a loss of consciousness for a concussion to occur (Theadom et al., 2014), and the reliance on athletes recognising and self-reporting concussion symptoms, it is estimated that up to 30% of SRC is unreported and untreated (Hardaker, 2018).

New Zealand's national insurance company, the Accident Compensation Corporation (ACC), collects data on the number of claims and the costs associated with the treatment

of SRC (King et al., 2014). Between 2014 and 2018, across seven sporting codes (rugby union, football, rugby league, netball, hockey, touch rugby, and softball/baseball), those aged between 16 to 19 years lodged 8,498 ACC claims related to SRC. Rugby union represented 43.9% (3,728) of these claims, followed by 8.7% (737) in rugby league and 7.6% (644) in football. The total cost of claims within this age group was NZ$4,348,499, with rugby union again well ahead with 33.7% (NZ$1,466,020) of the total cost, followed by football with 7.8% (NZ$340,517), and cycling with 7.7% (NZ$336,435) (ACC, 2019). Unfortunately, as ACC data are only available for those who actively seek treatment, they do not provide an accurate representation of SRC in New Zealand and may indicate a level of underreporting of the condition. Furthermore, it is not possible to demonstrate the level of participation in sport of those sustaining SRC, the number of missed matches and trainings, and time spent in hospital or absent from school from these data (King et al., 2018).

Individuals who are unable to identify the signs and symptoms of concussion are unlikely to report them, meaning athletes with limited or incomplete knowledge of concussion could be at risk of delayed recovery or further injury (Fedor & Gunstad, 2015). A survey by Reid et al. (2018) assessed New Zealand secondary school students' knowledge and attitudes toward concussion in sport. This study highlighted that New Zealand secondary school students had good knowledge around concussion but that further education was required to increase their understanding of some of the symptoms of SRC, including amnesia, nausea, and insomnia. Further, it indicated that students did not appreciate that the symptoms of concussion may not be immediately evident and can emerge up to several days following injury. Students also lacked knowledge regarding the time frames for return to sport, the potential impact of multiple concussions, and the detrimental effects of electronic devices on cognitive recovery following concussion.

Whilst adequate knowledge is essential for youth athletes to understand and appropriately manage concussion, knowledge alone does not always lead to appropriate reporting behaviour. A key determinant of whether an athlete reports or intends to report their symptoms is their attitude toward SRC (Sye et al., 2006). When a lack of knowledge is excluded, the most common reasons youth athletes do not report symptoms of concussion are believing the injury is not serious enough to warrant medical attention and not wanting to be withheld from competition (Kurowski et al., 2015). Athletes reporting of concussion is negatively influenced by the fear of losing playing time, being involved in a game-versus-practice situation, and not wanting to let others down (Kay et al., 2015). To ensure athletes are communicating when they experience a potential concussion, it is critical that they are not only able to recognise the signs and symptoms of SRC but also understand the importance of reporting when they suspect a concussion has occurred (Wallace et al., 2017).

Weber et al. (2019) found that a positive attitude towards intent to report SRC does not necessarily translate to actual reporting behaviours. The way athletes approach the reporting of their concussion is strongly influenced by how they believe the injury will be managed, including how long they think they will be excluded from trainings and games (Register-Mihalik et al., 2017). An athlete's perception of the short- and long-term consequences of a concussion will also influence their approach to management, with those who believe that concussion is an insignificant injury being less likely to follow an appropriate rehabilitation programme (Register-Mihalik et al., 2017). Actual or perceived pressure to continue training or playing following a concussion also influences players' intentions to report concussion (Kroshus et al., 2015). Improving player knowledge alone does not entirely address concerns around concussion reporting and management. Therefore, in addition to promoting players' knowledge of concussion, it is vital that education initiatives address player attitudes towards concussion management (Kearney & See, 2017).

In 2017, a survey was undertaken by Reid et al. (2018) investigating the knowledge, attitudes and behaviours (KAB) of secondary school students following the release of the ACC guidelines in 2016 on the management of SRC in New Zealand (ACC, 2016). This survey was repeated in 2018 following the release of an ACC media campaign to increase the KAB of SRC in secondary school students (Reid et al., 2019). Therefore, the aim of this study was to compare the results of the 2017 and 2018 secondary school student surveys and investigate the impact of the ACC social media campaign on the New Zealand KAB regarding SRC.

METHODS

This study used a cross-sectional questionnaire design to ascertain the KAB of secondary school students in regard to SRC. The design of the 35-item, multi-choice questionnaire was based on previous studies of this nature (Murphy et al., 2015; Register-Mihalik et al., 2013; Sye et al., 2006). Four additional questions regarding behaviours towards SRC, which were not addressed in 2017, were added to the 2018 survey. These questions examined behaviours of players, coaches, and referees concerning the on-field management of concussion, such as asking participants if they had observed players being encouraged to play if a concussion had occurred.

Participants and recruitment

The 2018 secondary school student survey was undertaken between September and December 2018 in the North Island, encompassing a range of sporting events, most of which were held during School Sport New Zealand's Winter Tournament Week (September holiday period) (Table 1). Participants were aged 16 years or older, were involved in organised, coached secondary school sports or had recently left school. A participant information sheet was provided along with a hard copy of the survey, and as the survey was anonymous, consent was gained by the student being willing to complete the survey. Ethical approval was provided by Auckland University of Technology Ethics Committee (reference number 16/187) and the ACC Ethics Committee.

Intervention

Coinciding with the KAB data collection, ACC delivered a social media campaign to all students, parents, and coaches attending Tournament Week. This campaign comprised of one post on a

Table 1
Secondary School Students' 2018 Survey: Events, Sports and Locations

Event	Sport	Venue and date	Projected numbers
National Secondary Schools Tournament	Rugby league	Bruce Pullman Park, Auckland, September 3-7, 2018	528
Jock Hobbs Memorial National Under 19 Tournament	Rugby	Taupo, September 8-15, 2018	400
Schick Premierships AA Zone 2	Basketball	Rotorua Events Centre, Rotorua, September 5-7, 2018	330
New Zealand Secondary Schools Premiership Zone 2	Basketball	Central Energy Trust Arena, Palmerston North, September 5-8, 2018	370
Schick Premierships AA Zone 1	Basketball	North Shore Events Centre, Auckland, September 5-8, 2018	370
Schick Northern Cup	Basketball	Bruce Pullman Park, Auckland, September 5-7, 2018	250
New Zealand Secondary School Champs	Netball	Blake Park, Mt Maunganui, September 3-6, 2018	1,488
National Age Group Tournament	Football	Wellington, December 10-15, 2018	47
Total			3,756
Completed surveys			1,327
Response rate			35.3%

different aspect of concussion management shared via the ACC SportSmart Facebook page each day of the tournament. The following key messages were delivered:

- Suspect a concussion? If in doubt, sit them out. Concussion is serious – a doctor needs to check the player before they get back into the game.
- If you have a concussion, patience is key. It can take time for the brain to heal so it's important to allow yourself time out to ensure you are symptom free. Only get back onto the field once your doctor has said it's ok.
- What does a concussion look like? If a player seems confused, slower than usual, or is unbalanced, remove them from play and get them checked by a doctor.
- If a mate takes a knock in the game and looks like they're having a hard time with easy tasks, talk to them. A lack of concentration, blurry vision, and feeling sick or vomiting can be symptoms of concussion.
- Recognise the signs – https://www.accsportsmart.co.nz/concussion-2/.

The posts had a combined reach of 3,938 people, 521 engagements, 33 likes, 19 shares, and one comment.

Data analyses

All data from 2017 and 2018 were analysed descriptively via SPSS v25 (BM Corp, Chicago, Illinois, USA). Means and standard deviations were reported as appropriate for the data collected. *t*-tests were used to investigate between group comparisons for key variables of the two survey years. The *p* value was set at 0.05.

RESULTS

Of the 3,756 estimated attendees at the sporting tournaments, 1,327 students were recruited (Table 1), with an approximate response rate of 35.3%. Table 2 details the demographic characteristics of the participants who completed the survey.

Demographics

The gender of those who completed the survey differed between 2017 and 2018, with 17.6% of the 2017 respondents being female versus 60.3% in 2018. The number who identified as New Zealand Pākehā was 49.3% (2017) and 58.3% (2018); and as Māori was 23.2% (2017) and 33.5% (2018). The most common sport played in 2017 was rugby union, whereas in 2018, it was netball (approximately 50% of students). The majority of participants played sport at a regional level, and this had changed slightly over the two survey periods (43.4% vs 44.4%). Those with at least four years of playing experience increased from 70.6% (2017) to 87.2% (2018). The age of participants was similar for both years (mean age 17 ± 1.0 years).

Knowledge of concussion

Table 3 contains the responses to the 20 knowledge items in the survey. In this section of the questionnaire participants were able to choose more than one answer. There was no statistical difference in the mean scores for overall knowledge items from 2017 (15.2, SD 2.5 in both years; p = 1.00), with the range of correct answers falling between seven and 20 for both years. There was no difference in the response rates by sport code. The term "concussion" was known to 93% in 2018 (94% in 2017) of participants. When compared to 2017, more students in 2018 students were able to identify the most common signs and symptoms of blurred vision (79.1% 2017 vs 84.9% 2018),

Table 2

Demographics of the Students who Completed the Secondary School Students' Survey in 2017 and 2018

Demographic characteristics	2017 (*n* = 807)	Frequency or SD (%)	2018 (*n* = 1327)	Frequency or SD (%)
Age (years)	Mean 17.0	SD 1.1 Range 16 - 20	Mean 17.0	SD 1.0 Range 16 - 21
Gender				
Male	661	81.9%	524	39.7%
Female	142	17.6%	800	60.3%
Ethnicity				
New Zealand Pākehā	398	49.3%	773	58.3%
Māori	187	23.2%	444	33.5%
Pacific Peoples	151	18.7%	296	22.3%
Asian	42	5.2%	52	39.2%
Middle Eastern	5	0.6%	22	1.7%
Other	24	3.0%	24	1.8%
Main sport played				
Rugby union	418	51.8%	297	22.4%
Basketball	294	36.4%	340	25.6%
Netball	44	5.5%	656	49.4%
Rugby league	29	3.6%	61	4.6%
Other	19	2.4%	119	8.9%
Football (soccer)	2	0.2%	27	2.0%
Type of school				
Co-education	394	48.8%	832	62.7%
Left school	205	25.4%	225	17.0%
Single sex male	139	17.2%	94	7.1%
Single sex female	61	7.6%	179	13.5%
Highest participation level				
Regional	350	43.4%	589	44.4%
School	251	31.1%	522	39.3%
National	176	21.8%	210	15.8%
Club	22	2.7%	139	10.5%
Recreational	5	0.6%	12	0.9%
Number of years played				
4 years	570	70.6%	1157	87.2%
3 years	76	9.4%	94	7.1%
2 years	65	8.5%	46	3.5%
1 year	56	6.9%	30	2.3%

Note. The data have been extracted with permission from two reports commissioned by ACC (Reid et al., 2018; Reid et al., 2019). For responses related to ethnicity, sports played, and highest level of participation, participants could select more than one response. *n* = number; SD = standard deviation.

confusion (76.0% 2017 vs 79.7% 2018), dizziness (81.8% 2017 vs 83.2% 2018), headache (83.6% 2017 vs 85.7% 2018), and loss of consciousness (64.7% 2017 vs 69.1% 2018). There was a reduction in concussion information sourced from medical professionals, such as doctors and physiotherapists (55.8% 2017 vs 43.8% 2018), and from teachers and coaches (54.4% 2017 vs 49.4% 2018), with sports clubs also slightly reduced (21.2% 2017 vs 17.3% 2018). ACC as a source of information on concussion remained low between both years (7% 2017 vs 10% 2018). Regarding decision-making related to returning to training and games after a concussion, a doctor was correctly identified by participants as the most competent person to judge when a player was ready to return to sport (87% 2017 vs 91% 2018).

Gaps identified in the students' knowledge of concussion included the ability to understand what amnesia was. Insomnia and nausea were less well-known persistent symptoms of concussion. Loss of consciousness was correctly identified as a key symptom by only 64.7% in 2017 vs 69.1% in 2018. There was a decrease in those who thought, incorrectly, that headgear would reduce concussion, with 55.6% suggesting this was correct in 2017 and 46.1% in 2018. There was a small increase in awareness that the use of blue screen devices, such as a phone to deliver text messages or similar activities requiring

Table 3

Knowledge of Concussion of the Students who Completed the Secondary School Students' Survey in 2017 and 2018

Knowledge items	Frequency (%) of correct answers	
	2017 (*n* = 807)	2018 (*n* = 1327)
Statements which students considered to be a sign or symptom of concussion		
Skin rash (false)	781 (96.7)	1262 (95.1)
Abnormal sense of smell (false)	755 (93.6)	1171 (88.2)
Abnormal sense of taste (false)	751 (93.1)	1174 (88.4)
Joint stiffness (false)	747 (92.6)	1167 (87.9)
Bleeding from the mouth (false)	731 (90.6)	1177 (88.6)
Fever (false)	725 (89.8)	1107 (83.4)
Black eye (false)	717 (88.8)	1127 (84.9)
Bleeding from the nose (false)	662 (82.0)	991 (74.6)
Sharp burning pain in the neck (false)	674 (83.5)	1027 (77.7)
Dizziness (true)	660 (81.8)	1104 (83.2)
Headache (true)	675 (83.6)	1137 (85.7)
Bleeding from the ear (false)	649 (80.4)	996 (75.1)
Blurred vision (true)	638 (79.1)	1127 (84.9)
Confusion (true)	613 (76.0)	1058 (79.7)
Weakness in neck movements (false)	547 (67.8)	824 (62.1)
Loss of consciousness (true)	522 (64.7)	917 (69.1)
Nausea (true)	388 (48.1)	767 (56.5)
Amnesia (true)	317 (39.3)	725 (54.6)
Numbness or tingling of the arms (false)	628 (77.8)	982 (74.0)
Insomnia (true)	108 (13.3)	249 (18.8)
Sources of information on concussion		
Teacher/coach	439 (54.4)	656 (49.4)
Other players	192(23.8)	358 (27)
Doctor/physiotherapist	450 (55.8)	581 (43.8)
Accident Compensation Corporation	58.0 (7.2)	139 (10.5)
Sport Clubs	171 (21.2)	230 (17.3)
Which of the following players would you say might be "concussed"?		
A player complains of stinging or burning in his calf muscles (false)	778 (96.4)	1261 (95.0)
After a big knock/fall/head clash the player starts making wrong decisions or actions during the game (true)	546 (67.7)	912 (68.7)
After a ruck/fall/head clash a player is left on the ground not moving (true)	534 (66.2)	1017 (76.6)
A teammate is complaining of headaches and blurred vision (true)	507 (62.8)	913 (68.8)
In the team room a couple of hours after the game a teammate complains of feeling sick with a headache (has not been drinking alcohol) (true)	392 (48.6)	631 (47.6)
General knowledge		
Concussion is an injury to the (correct answer brain or head)	771 (95.6)	1275 (96.1)
Concussion only occurs if you lose consciousness (false)	686 (85.0)	1139 (85.8)
If you are experiencing concussion signs and symptoms after a head knock or sudden movement to the body, you should not return to play (true)	680 (84.3)	1086 (81.8)
What are the possible complications of multiple concussions?		
No complications exist (false)	772 (95.7)	1256 (94.6)
Joint problems (false)	693 (85.9)	1236 (93.1)
Brain damage (true)	583 (72.2)	994 (74.9)
Memory problems (true)	499 (61.8)	882 (66.5)
Increased symptoms (true)	318 (39.4)	582 (43.9)
Increased risk of further injury (true)	306 (37.9)	640 (48.2)
Don't know	98 (12.1)	182 (13.7)

Knowledge items	Frequency (%) of correct answers	
	2017 (*n* = 807)	2018 (*n* = 1327)
What are the possible complications of returning to play too soon?		
No complications exist (false)	786 (97.4)	1265 (95.3)
Joint problems (false)	768 (95.2)	1192 (89.8)
Paralysis (false)	627 (77.7)	982 (74.0)
Brain damage (true)	517 (64.1)	878 (66.2)
Increased risk of further injury (true)	478 (59.2)	898 (67.7)
Reduced sports performance (true)	371 (46.0)	739 (55.7)
Unsure of answer	107 (13.3)	172 (13.0)
If a player gets concussed, how long should they wait before returning to training or games?		
Straight back on	14 (1.7)	29 (2.2)
1 week	11 (1.4)	69 (5.2)
2 weeks	64 (7.9)	155 (11.5)
3 weeks	74 (9.2)	276 (20.8)
4 weeks	74 (9.2)	224 (16.9)
When fully recovered	273 (33.8)	579 (43.6)
Don't know	193 (23.9)	170 (12.8)
What does headgear prevent?		
Neck injury (false)	767 (95.0)	1142 (86.1)
Skull fracture (false)	579 (71.7)	807 (60.8)
Concussion (false)	449 (55.6)	612 (46.1)
Cauliflower ears (true)	415 (51.4)	686 (51.7)
Cuts and grazes (true)	205 (25.4)	284 (21.4)
Don't know	83 (10.3)	118 (8.9)
Don't have contact with sports that use headgear	43 (5.3)	92 (6.9)
Which activities should be avoided following a concussion?		
Gym training (true)	545 (67.5)	958 (72.2)
Going to sleep (false)	511 (63.3)	820 (61.8)
TV (false)	453 (56.1)	613 (46.2)
Jogging (true)	446 (55.3)	847 (63.8)
Texting (true)	317 (39.3)	634 (47.8)
Facebook (true)	309 (38.3)	613 (46.2)
Long walks (true)	259 (32.1)	482 (36.3)
School work (true)	257 (31.8)	491 (37.0)
Who is the best person to decide return to train/play after a concussion?		
Parents/caregivers (false)	731 (90.6)	1202 (90.1)
Coach (false)	700 (86.7)	1188 (89.5)
Doctor (true)	702 (87.0)	1192 (89.8)
Self (false)	698 (86.5)	1161 (87.5)
Other (false)	12 (1.5)	40 (3.0)

Note. For some questions, more than one answer was possible, meaning the number of responses for some categories was more than the total number of participants. The data have been extracted with permission from two reports commissioned by ACC (Reid et al., 2018; Reid et al., 2019). *n* = number.

cognitive function, may need to be avoided until symptoms have settled (39.3% 2017 vs 47.8% 2018). There was a small increase in the number who indicated that it was safe to return to play only when symptoms have resolved (33.8% 2017 vs 43.6% 2018).

Attitudes towards concussion

Table 4 outlines the responses to the attitude items of the survey. These questions examined the current awareness of concussion and how effectively it is presently being managed. Participants tended to "strongly agree" and "agree" (80.2% 2017 vs 71.9% 2018) that guidelines should be followed at

school level, but there was no change in the view that there was a need to provide better education around concussion and improve reporting (73.5% "strongly agree" and "agree" in both 2017 vs 75.0% in 2018). There were no statistical differences in attitude responses between 2017 and 2018.

Behaviour items

Four additional questions in the 2018 survey asked about behaviours of players, coaches, and referees with respect to the on-field management of concussion. These questions asked participants if they had observed players being encouraged to play if a concussion had occurred. Items were rated from "very often" to "never" (Table 5).

With respect to the question "Have you seen players playing on with a suspected concussion when you thought they should not have?", the majority of respondents stated this "rarely" or "never" happened (48.2%), but 26.9% stated this "sometimes" happened. It "rarely" or "never" happened that coaches and referees encouraged players to keep playing (72.8% and 76.3% respectively). Approximately 75% of respondents stated that it "rarely" or "never" happened that players put pressure on other players to play on with concussion. Overall, these are positive behaviour responses.

Table 4

Attitudes Towards Concussion of the Students who Completed the Secondary School Students' Survey in 2017 and 2018

Attitudes towards concussion	Frequency (%)	
	2017 (*n* = 807)	2018 (*n* = 1,327)
Concussion guidelines should be followed at school		
Strongly agree	328 (43.1)	476 (35.9)
Agree	282 (37.1)	478 (36.0)
Not sure	79 (10.4)	245 (18.5)
Disagree	11 (1.4)	28 (2.1)
Strongly disagree	61 (8.0)	110 (8.3)
Concussions are often not reported		
Strongly agree	89 (11.7)	202 (15.2)
Agree	310 (40.8)	609 (45.9)
Not sure	227 (29.9)	390 (29.4)
Disagree	97 (12.8)	98 (7.4)
Strongly disagree	36 (4.7)	58 (4.4)
Perceived seriousness of headache and dizziness after head knock		
Not serious	33 (4.4)	50 (3.8)
Mildly serious	106 (14.4)	144 (10.9)
Moderately serious	244 (33.2)	405 (30.5)
Very serious	269 (36.6)	542 (40.8)
Extremely serious	102 (13.9)	248 (18.7)
Players should not participate in physical activity with concussion signs and symptoms		
Strongly agree	240 (31.9)	531 (40.0)
Agree	353 (46.9)	572 (43.1)
Not sure	91 (12.1)	153 (11.5)
Disagree	32 (4.2)	36 (2.7)
Strongly disagree	37 (4.9)	57 (4.3)
It is important to understand how concussion happens		
Strongly agree	337 (44.8)	676 (50.0)
Agree	325 (43.2)	504 (38.0)
Not sure	59 (7.8)	119 (9.0)
Disagree	9 (1.2)	10 (0.8)
Strongly disagree	23 (3.1)	32 (2.4)

Attitudes towards concussion	Frequency (%)	
	2017 (*n* = 807)	2018 (*n* = 1,327)
It is important to understand concussion prevention		
Strongly agree	373 (49.5)	647 (48.8)
Agree	293 (38.9)	514 (38.7)
Not sure	59 (7.8)	103 (7.8)
Disagree	8 (1.1)	20 (1.5)
Strongly disagree	20 (2.7)	32 (2.4)
It is important to understand what to do if you see a concussion		
Strongly agree	436 (58.2)	670 (50.5)
Agree	248 (33.1)	508 (38.3)
Not sure	41 (5.5)	85 (6.4)
Disagree	8 (1.1)	17 (1.3)
Strongly disagree	16 (2.1)	15 (1.1)
Possible concussion should be reported to medical professional		
Strongly agree	366 (49.0)	656 (49.4)
Agree	308 (41.2)	563 (42.4)
Not sure	52 (7.0)	100 (7.5)
Disagree	7 (0.9)	18 (1.4)
Strongly disagree	14 (1.9)	16(1.2)
Coaches and referees should be informed of concussion signs and symptoms		
Strongly agree	364 (48.6)	716 (54.0)
Agree	306 (40.9)	494 (37.2)
Not sure	55 (7.3)	90 (6.8)
Disagree	14 (1.9)	4 (0.3)
Strongly disagree	10 (1.3)	15 (1.1)
Players are not well educated about concussion		
Strongly agree	199 (26.6)	404 (30.4)
Agree	350 (46.9)	592 (44.6)
Not sure	146 (19.5)	246 (18.5)
Disagree	40 (5.4)	62 (4.7)
Strongly disagree	12 (1.6)	16 (1.2)

Note. The data have been extracted with permission from two reports commissioned by ACC (Reid et al., 2018; Reid et al., 2019). Not all students answered all questions, meaning the number of responses for some categories was less than the total number of participants; in others more than one answer was possible, meaning the number of responses for some categories was more than the total number of participants. *n* = number.

DISCUSSION

The main findings of this study suggest that the ACC social media campaign did not significantly alter the KAB of the survey participants. Students remain knowledgeable regarding concussion and show positive attitudes towards correct management of the injury. There are some specific knowledge gaps regarding onset of symptoms; activities to avoid post-concussion; the possible complications of multiple injuries; and recognition of less discernible symptoms of concussion, such as amnesia, nausea, and trouble sleeping. The results suggest that secondary school students would benefit from further education on the possible long-term effects of concussion and the importance of effective management once a concussion has occurred. Currently, most of the information students receive on the awareness and management of concussion comes from schools, teachers/coaches, and medical professionals, with very little from ACC. This suggests the channels used to distribute information to secondary school students need to be considered for future campaigns.

Knowledge of concussion

Participants demonstrated good knowledge regarding common signs and symptoms associated with SRC, most commonly identifying blurred vision, confusion, dizziness, headache, and loss of consciousness. However, less obvious symptoms such as amnesia, insomnia, and nausea, which receive less coverage by mainstream media (Sullivan, Pursell, & Molcho, 2018), were omitted by approximately 40-45%, 80-85%, and 45-50% of students in both cohorts, respectively. This is consistent with

Table 5

Behaviours Towards Concussion of the Students who Completed the Secondary School Students' Survey in 2018

Questions and responses [a]	Frequency (%) (*n* = 1327)
Have you seen players playing on with a suspected concussion when you thought they should not have?	
Very often	189 (14.4)
Often	195 (14.7)
Sometimes	357 (26.9)
Rarely	346 (26.1)
Never	293 (22.1)
Have you seen coaches allowing players to play on with a suspected concussion?	
Very often	40 (3.0)
Often	94 (7.1)
Sometimes	215 (16.2)
Rarely	340 (25.6)
Never	627 (47.2)
Have you seen referees/umpires allowing players to play on with a suspected concussion?	
Very often	38 (2.9)
Often	59 (4.4)
Sometimes	197 (14.8)
Rarely	334 (25.2)
Never	678 (51.1)
Have you seen players putting pressure on other players to play on with a suspected concussion?	
Very often	58 (4.4)
Often	85 (6.4)
Sometimes	180 (13.6)
Rarely	272 (20.5)
Never	732 (55.2)

Note. The data have been extracted with permission from two reports commissioned by ACC (Reid et al., 2018; Reid et al., 2019). Not all students answered all questions, meaning the number of responses for some categories was less than the total number of participants. *n* = number.

[a] Answers scored on a scale of 1 (very often) to 5 (never).

other studies which have found amnesia and nausea (Register-Mihalik et al., 2013; Wallace et al., 2017), and disturbed sleep (Hecimovich et al., 2016) are commonly unrecognised symptoms associated with SRC. It is unclear whether the lack of awareness of the less common symptoms is due to reduced knowledge or a misunderstanding of the terms used to describe the symptoms. Different terminology may need to be used with students, for example substituting "insomnia" with "problems sleeping". However, similar studies which used more basic terms found comparable results (Hecimovich et al., 2016; Register-Mihalik et al., 2013). Another potential explanation is that students may have been confused by this question, because some symptoms of SRC can be associated with other conditions, such as nausea with dehydration (Register-Mihalik et al., 2013). Bleeding from the mouth, nose, and ear was correctly identified as not being a symptom of concussion by many participants, with only between 20-25% selecting "bleeding from the ear" as correct. This indicates that participants had a good ability to isolate the brain injury from other facial trauma. Although these values had decreased slightly from the 2017 survey findings, when compared to high school athletes in the United States, the New Zealand sample demonstrated similar knowledge level in this area (Register-Mihalik et al., 2013).

The students showed a good level of awareness regarding the importance of avoiding physical activity following a concussion. However, less than half were able to correctly identify that cognitive exertion should also be avoided. Cognitive activities impose additional neurometabolic demand on the brain. Symptom exacerbations during cognitive tasks can indicate that the demands of the task are beyond the limits of the recovering brain (Valovich McLeod & Gioia, 2010). Between 2017 and 2018, there was a slight improvement in students' knowledge regarding the negative impact of cognitive overstimulation, such as texting, Facebook, and schoolwork. However, the data indicate that students are still unaware of the impact cognitive exertion can have on recovery after a concussion. Our findings are similar to those of the study by Sullivan et al. (2012), who investigated university students understanding of the term "rest" following a concussion. They found that the majority (74%) of students could correctly identify physical rest was

required, but only 25% correctly identified that cognitive rest is also required. Encouragingly, following a single education seminar, 96% of participants could identify the need for cognitive rest. This indicates that further information is necessary in this area.

Students were asked to apply their knowledge of concussion signs and symptoms to hypothetical practical scenarios. The concussion symptoms exhibited in these scenarios were impaired decision-making, headache, blurred vision, loss of consciousness, and nausea. These symptoms were correctly identified by approximately 60-70% of the 2018 participants, which was almost identical to the 2017 survey results. Students were less able to spot the possible impact of concussion in the scenario where there was a delayed onset of symptoms (48%). The awareness that concussion has a negative effect on performance increased slightly from 46.0% to 55.7%, but this message still requires further highlighting in education programmes.

The Concussion in Sport Group consensus statement recommends a graduated rehabilitation strategy, whereby after a brief period of initial rest, symptom-limited activity can begin. The athlete may proceed to the next level only when they meet all the performance criteria without a recurrence of concussion-related symptoms. It is recommended that an athlete may only be medically cleared to return to play once they are asymptomatic during simulated training (McCrory et al., 2017). Worryingly, less than half (43.6%) of the students in 2018 could identify that players should not return to play until all symptoms had resolved. Whilst this response rate has increased from 2017 (33.8%), this should be identified as a key area of further education for all sporting codes. These results are similar to a survey of New Zealand high school-aged rugby players which found that fewer than half of the players were aware of return-to-play guidelines and that after a concussion 52% of players made their own decision to return to play, with only 22% returning after medical clearance (Sye et al., 2006). A large percentage (approximately 45-55%) of respondents also believed, incorrectly, that headgear can prevent concussion. This is an area that requires significant education in the future.

Attitudes towards concussion

Overall the students had a very positive attitude to the management of concussion, and understood the importance of following the guidelines and recognising symptoms. Our results are similar to the findings of Register-Mihalik et al. (2013), who found that high school athletes had good attitudes towards recognising and managing concussion. An increasing number of students in this survey (61.1% in 2018) felt concussion was often not reported. These figures align with a recent survey which found similar numbers of secondary students hid or downplayed their sports injuries (Whatman et al., 2018). Our data may have been skewed by the high number of female respondents; despite having similar levels of knowledge, due to a variety of reasons, including not wanting to look weak or let the team down, males are between four and 11 times less likely to report suspected concussion than females (Wallace et al., 2017).

Behaviour items

In the 2018 survey, four additional questions were included that specifically asked about player, coach, and referee behaviours toward players who may have been concussed. The responses show that it was rare to see pressure being put on players to continue playing with concussion. Whilst this finding is encouraging, others have found evidence to the contrary. Kroshus et al. (2015) found that those who had a history of concussion felt significantly higher pressure from coaches and teammates to continue playing in the event of a suspected concussion. In the same study, a player's decision to not report concussion symptoms was influenced by pressure from teammates and parents, but not coaches. Studies investigating the effect of educational interventions on students' KAB found that although knowledge and intention to report concussion increases post intervention, the actual reporting behaviours remain the same (Sullivan et al., 2018). Wallace et al. (2017) found that rather than participating in specific SRC education programmes, the key factor that increased college athlete's knowledge around concussion was having access to an athletic trainer. However, reporting behaviour was not influenced by having increased SRC knowledge.

Strength and weaknesses

A large number of surveys were completed in both 2017 and 2018, with 520 more surveys being completed in 2018 compared to 2017, and the data were collected from a range of sports reflective of those played at secondary school level in New Zealand. Weaknesses of this study include a low survey response rate of 35% (in 2018). As participants were a self-selected sample of convenience, the sample may not have accurately represented the target population, and this may have biased responses towards those with an interest in or already established knowledge of SRC. Those with lower literacy may have been less inclined to participate due to the survey format. As there are known gender differences in attitudes towards concussion, the different proportions of male and female participants between 2017 and 2018 may have influenced the results.

Clinical implications

Considering the main findings of this report, we recommend that physiotherapists, medical doctors, sporting bodies, and ACC consider implementing the following practical considerations:

1. When either acting as the sideline physiotherapist or treating those with injuries secondary to SRC, physiotherapists are often the first-line treatment of SRC. Physiotherapists are therefore responsible for providing appropriate education and guidance regarding rest, recovery, and graduated return to sport following SRC. To improve student athletes' knowledge and management of SRC, physiotherapists should ensure they focus their education efforts on the common areas of confusion around SRC highlighted in this report, including the need for cognitive rest, medical clearance, and the need for a graded return to sport.
2. Medical doctors need to be communicating with athletes, coaches, parents, and sporting bodies so that without

medical clearance an athlete may not be able to return to play. It may be of benefit for medical doctors to provide stand-down notifications for those who have been diagnosed with SRC which can only be lifted with medical approval. There is currently no requirement for the doctor assessing an athlete to specialise in sport or concussion. In some cases, general practitioners with limited resources may be the person providing final clearance, highlighting the importance of having clear communication between medical doctors and the athletic support staff, who are perhaps more able to assess an athlete's readiness to return to play.

3. To ensure athletes receive consistent messaging about the recognition and appropriate treatment of SRC, it is important that guidelines are clear and consistent between national sporting bodies and ACC. There are currently conflicting concussion management strategies between sporting codes regarding return-to-play timeframes and criteria. Rugby has implemented a mandatory 23-day stand-down period for players under 19 years of age, whereas athletes in other sports who follow the ACC graded return to play guidelines could theoretically return to play within 7 days. Providing consistency between sporting bodies will reduce any confusion for both athletes and the medical professionals supporting their recovery and return to play. Regarding recognising symptoms and removing players from play, it may be beneficial for other sporting codes to take the lead from rugby union where the "blue card" initiative is used. By showing a blue card, the referee is empowered to remove a player if they believe or suspect a concussion has been sustained.

As ACC provide the guidelines and recommendations regarding concussion management and return-to-play protocols, it is surprising that ACC was not identified as a key resource for concussion information. Currently most of the information students receive on the awareness and management of concussion comes from schools, teachers/coaches, and medical professionals. This suggests the channels used to distribute information to secondary school students need to be considered for future campaigns. It may be beneficial to focus future campaigns at the groups listed above with the aim of having information passed on to students through these channels. It would be of benefit for ACC to focus education programmes on the areas identified in this report, such as recognition of less common symptoms, treatment, and return to play/school.

CONCLUSION

This report shows that the 2018 ACC social media campaign had very little effect on New Zealand secondary student athletes' KAB towards SRC. Our results highlight that students are knowledgeable about the common signs and symptoms of SRC. However, they lack knowledge concerning effective management of SRC, specifically regarding activities to avoid during recovery and the processes for return to play. Reassuringly, secondary school students exhibited positive attitudes and behaviours towards appropriate management of SRC, with it being rare to observe pressure to return to sport following a suspected SRC.

KEY POINTS

1. Secondary school students have good knowledge, attitudes and behaviours of SRC.
2. School students' knowledge of SRC has come from medical professionals, coaches and teachers.
3. Other than the current guidelines and the recent social media campaign, ACC should consider other avenues to increase knowledge and awareness of SRC in this population.

DISCLOSURES

This study was funded by ACC. ACC provided permission for the data to be re-presented from reports commissioned as part of a series of studies funded to gain knowledge of, and attitudes and behaviours towards SRC across a range of populations. There are no other conflicts of interest which may be perceived to interfere with or bias this study.

PERMISSIONS

Ethical approval was obtained from the Auckland University of Technology Ethics Committee (reference number 16/187) and the ACC Ethics Committee.

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