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KNOWLEDGE and ATTITUDES (KA) SURVEYS ON CONCUSSION IN SPORTS: SECONDARY SCHOOL STUDENTS SEPTEMBER 2017 SURVEY

REPORT #2 TO ACCIDENT COMPENSATION CORPORATION (ACC)

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OVERVIEW

This report is the second in a series presenting baseline Knowledge and Attitudes (KA) around concussion in sport. The first report (Reid et al., 2017) focused on referees' knowledge and attitudes, whilst this second report (Reid et al., 2018) focuses on secondary school students and is termed the "Secondary School Students September 2017 Survey".

The 'Sports Concussion in New Zealand ACC National Guideline' was released in 2014. The KA studies aim to assess current knowledge and attitudes of rugby participants towards concussion in sport following release of the guideline.

The results from the *Secondary School Students September 2017 Survey* suggest that the student-based sample of 807/2440 (33% response rate) are knowledgeable regarding concussion and show positive attitudes towards correct management of the injury. However, students expressed a need to know more about how concussion happens, and its prevention and management. Thirty five percent of the students who participated in the survey reported experiencing a previous concussion, with nearly 40% of these having more than 1-2 episodes. Students reported receiving most information on concussion from medical professionals and their school. Sports clubs may need to be more proactive in concussion education for their particular sport. Only a small percentage (8%) recognised ACC as a source of information and guidance for concussion.

Recommendations

- Further education is required to increase understanding of some of the symptoms of sports concussion including amnesia, nausea and insomnia. Changes to simpler terms (e.g. difficulty remembering things, feeling sick and problems sleeping) in the ACC guidelines and educational material, and in the ACC KA surveys, may be needed to ensure students understand what the terms mean.
- Further education is needed with regards to the fact that onset of symptoms of concussion may not be evident immediately following injury and can emerge up to several days following injury.
- Further education is needed regarding the time frames to return to sport – noting that the physiology of the brain is the same no matter what the sport, but that different sports have different recommendations on management. In New Zealand the current ACC guidelines should be used as the minimum time frame for return to sport, given they were endorsed by the ACC led Sport Collaboration Group.
- Further education and research is required regarding the potential impacts of multiple concussions.
- Further education and research is required regarding avoiding the use of devices that may affect cognitive function after concussion.
- Further education is required regarding how head gear use does not reduce the risk of concussion, and may increase injury risk due to change in athlete risk taking behaviour.
- Sports clubs may need to take a more active role in sports concussion education given rates of information provision from them was reported to be low. Sports clubs are able to be more proactive than health professionals who students see only after an injury has occurred.
- Continuing education programmes are required to ensure the current overall high levels of knowledge in the student group remain high. Schools and medical professionals are key providers of education, but ACC visibility can improve.
- Awareness of the ACC Guidelines can be further increased.
- Knowledge changes over time need to be measured to assess the effectiveness of ACC (and other groups) concussion strategies.

INTRODUCTION

The aims of the KA concussion research programme are to undertake surveys of secondary school students, coaches, parents, referees, and general practitioners to understand their current knowledge and attitudes towards the management of concussion. This report overviews the findings from secondary school students.

The key outcomes of this review are:

- **A comprehensive overview of the KA of sports related concussion in secondary school students, after the implementation of the ACC Sports Concussion Guidelines.**
- **Recommendations for key areas where improvements can be made to improve KA of concussion.**

Sport related concussion is a significant problem in New Zealand sporting populations (Theadom et al., 2014). It has been estimated that 21% of all traumatic brain injuries (TBI) are sustained in the sports arena. Rugby, cycling and equestrian activities have been identified as the most common cause of mild-TBI/concussion in sports (Theadom et al., 2014).

In 2006, a survey of 600 NZ Secondary school rugby players (Sye et al., 2006), demonstrated that at that time, only half of the players were aware of any guidelines for the management of concussion. Approximately half of the players also identified they had been concussed but only 22% had been medically cleared to return to sport. This demonstrated a significant lack of understanding of the management of this condition.

In 2014 The Accident Compensation Corporation (ACC, 2014) released a guideline on the management of sports concussion. A study of secondary school rugby players in NZ (Murphy et al., 2015) collected data on concussion awareness just prior to the release of the ACC guideline. Whilst knowledge of concussion was generally good, more than half of the players felt that they didn't know enough about concussion and reported that their response to concussion would depend on the nature of the game. For example, if the student perceived the importance of the game was high, such as in a season final, they reported they should play on for the sake of the team, but if it was only a training session or weekly game, then they would not play.

Purpose

The purpose of the *Secondary School Students September 2017 Survey* was to assess the current state of knowledge and attitudes around concussion guidelines and management for secondary school players in 2017 and to understand if there is need for an intervention to address any gaps in knowledge.

METHODOLOGY

Data collection process

The *Secondary School Students September 2017 Survey* was undertaken in the months of September and October at the events and venues outlined in Table 1.

Table 1: Secondary School Students September 2017 Survey areas and sports.

Event	Sport	Venue and date	Projected numbers of competitors
National Secondary Schools Tournament	Rugby League	Bruce Pulman Park, Auckland, September 4th-8th 2017	528
Jock Hobbs U19s Tournament	Rugby	Taupo, September 9th–16th 2017	400
Secondary Schools Top 4 Tournament	Rugby	Palmerston North, September 9th–16 th 2017.	328
AA Secondary Schools Premierships Zone 2	Basketball	Tauranga, September 5 th –8th 2017	370
Secondary Schools Premierships Zone 1 (Nationals Qualifier)	Basketball	Albany, September 5 th –8th 2017	350
Northern Secondary Schools Cup Zone 1 (Non-Qualifier)	Basketball	Papakura, September 5th–8th 2017	320
NZ Secondary School Champs	Netball	Rotorua, 10th–13th October 2017	144
Total			2440

The methodology used to ascertain the Knowledge and Attitudes (KA) of the secondary school students used a cross-sectional questionnaire design. The 35-item multi-choice questionnaire for the students was designed based on previous studies of this nature by Murphy et al. (2015), Sye et al. (2006) and Register Mihalik et al. (2013).

Ethical approval was provided by AUTECH Application #16/187. The ACC Ethics Committee also approved the study.

Participants and their recruitment

Participants were 16 years of age or older, had to be involved in organised coached secondary school sports or have recently left school. Of the 2,440 estimated attendees at the attended sports events, 807 students were recruited (See Table 2), therefore the response rate was 33%.

Data analysis

All data were analysed descriptively via SPSS. Means and standard deviations and 95% confidence intervals are reported as appropriate for the data gained. Chi-squared statistics and t tests were used to investigate between group comparisons for key variables. The p-value was set at 0.01 given the multiple comparisons undertaken.

RESULTS

Participants

Table 2 details the demographic characteristics of the participants who completed the survey. The majority of those who completed the survey were male (82%) and of New Zealand Pakeha ethnicity (49%). Rugby Union at a regional level was the most common sport played (52%) with at least four years of experience declared by 70% of these participants. The age range recruited from was 16 to 20. The survey participants mean age of 17 years was as expected for this population.

Table 2: Demographics of the 807 secondary school students who completed the *Secondary School Student 2017 Survey*.

Demographic characteristic	Mean \pm SD or Frequency (%)
Age	Mean 17.0 \pm 1.1 (95% CI 16.9, 17.31) range 16-20
Gender	Male 661 (82) Female 142 (18)
Ethnicity	New Zealand Pakeha 398 (49) Māori 187 (23) Pacific Islands 151 (19) Asian 42 (5) Other 24 (3) Middle Eastern 5 (0.6)
Main sport played	Rugby Union 418 (52) Basketball 294 (36) Netball 44 (5) Rugby League 29 (4) Other 19 (2) Soccer 2 (0.2)
Type of school	Co-educational 394 (49) Left school 205 (25) Single sex male 139 (17) Single sex female 61 (8)
Highest level of participation	Regional 350 (43) School 251 (31) National 176 (21) Club 22 (3) Recreational 5 (0.6)
Number of years played	4 years 570 (71) 3 years 76 (9) 2 years 65 (8) 1 year 56 (7)

Knowledge of concussion

Table 3 consists of the responses for eight of the 15 knowledge items in the survey. Participants were able to choose more than one answer in this section of questionnaire. The term concussion was known to 94% of participants. The most common signs and symptoms identified for concussion were blurred vision (79%), confusion (76%), dizziness (82%), headache (84%) and loss of consciousness (65%). The majority of participants obtained their information on concussion from a medical professional (56%), teachers and coaches (54%), and sports clubs (17%). Other providers of information were media (7%), parents (6.8%), and ACC (8%) with most participants selecting multiple options.

Regarding decision-making related to returning to training and games after a concussion, a doctor was correctly identified by 87% of participants as the most competent person to judge when a player was ready to return to sport.

Gaps in knowledge of concussion included the ability to understand what amnesia was. Insomnia and nausea were less well known persistent symptoms of concussion. Whilst loss of consciousness was identified as a key symptom this was true for only 65% of participants. There were low levels of awareness (40%) that blue screen devices such as a phone to deliver text messages and similar activities that require cognitive function may need to be avoided until symptoms have settled. Thirty four percent of participants recognised that the appropriate time to return to sport was greater than three weeks and only 34% indicated it was safe to return only when symptoms have resolved.

Table 3: Knowledge of concussion of the 807 secondary school students who completed the *Secondary School Student 2017 Survey*. Data are presented as frequency (%) unless otherwise stated.

Knowledge Items	Frequency (%) of correct answers
Please indicate which statements you would consider to be a sign or symptom of concussion:	
Skin rash (false)	781 (97)
Abnormal sense of smell (false)	755 (94)
Abnormal sense of taste (false)	751 (93)
Joint stiffness (false)	747 (93)
Bleeding from the mouth (false)	731 (91)
Fever (false)	725 (90)
Black eye (false)	717 (89)
Bleeding from the nose (false)	675 (84)
Sharp burning pain in neck (false)	674 (83)
Dizziness (true)	662 (82)
Headache (true)	660 (82)
Bleeding from the ear (false)	649 (80)
Blurred vision (true)	638 (79)
Confusion (true)	613 (76)
Weakness in neck movements (false)	547 (68)
Loss of consciousness (true)	522 (65)
Nausea (true)	388 (48)
Amnesia (true)	317 (40)
Numbness or tingling of the arms (true)	179 (22)
Insomnia (true)	108 (13)
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)
After a big knock/fall/head clash the player starts making wrong decisions or actions during the game (true)	546 (68)
After a ruck/fall/head clash a player is left on the ground not moving (true)	534 (66)
A team mate is complaining of headaches and blurred vision (true)	507 (63)
In the team room a couple of hours after the game a team mate complains of feeling sick with a headache (has not been drinking alcohol) (true)	392 (48)
General knowledge	
Concussion is an injury to the _____ (correct answer brain or head)	771 (95)
Concussion only occurs if you lose consciousness (false)	686 (85)
If you are experiencing concussion signs & symptoms after a head knock or sudden movement to the body you should not return to play (true)	680 (84)
What are the possible complications of multiple concussions?	
No complications exist (false)	772 (96)
Joint problems (false)	693 (86)
Brain damage (true)	583 (72)
Memory problems (true)	499 (62)
Increased symptoms (true)	318 (40)
Increased risk of further injury (true)	306 (38)
Don't know	98 (12)

What are the possible complications of returning to play too soon?	
No complications exist (false)	786 (97)
Joint Problems (false)	768 (95)
Paralysis (false)	627 (78)
Brain damage (true)	517 (64)
Increased risk of further injury (true)	478 (59)
Reduced sports performance (true)	371 (46)
Unsure of answer (false/not selected)	107(13)
Other (true)	23 (3)
If a player gets concussed, how long should they wait before returning to training or games?	
When fully recovered	273 (34)
3 weeks	193 (24)
Don't know	74 (9)
2 weeks	74 (9)
4 weeks	64 (8)
Straight back on	14 (2)
1 week	11 (1)
What does headgear prevent?	
Neck injury (false)	767 (95)
Skull fracture (false)	579 (71)
Concussion (false)	449 (56)
Cauliflower ears (true)	415 (51)
Cuts & grazes (true)	205 (25)
Don't know	83 (10)
Don't have contact with sports that use headgear	43 (5)
Which activities should be avoided following a concussion?	
Gym training (true)	545 (67)
Going to sleep (false)	511 (63)
TV (false)	453 (56)
Jogging (true)	446 (55)
Texting (true)	317 (39)
Facebook (true)	309 (38)
Long walks (true)	259 (32)
School work (true)	257 (32)
Who is the best person to decide return to train/play after a concussion?	
Parents/caregivers (false)	731 (91)
Coach (false)	700 (87)
Doctor (true)	702 (87)
Self (false)	698 (86)
Other (true)	14 (2)

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%) that guidelines should be followed at school level but 74% “strongly agree” and “agree” that there was a need to provide better education around concussion and improve reporting.

Table 4: Attitudes towards concussion of the 807 secondary school students who completed the *Secondary School Student 2017 Survey*.

Scored from a scale of 1 (strongly agree) to 5 (strongly disagree)	Mean \pm SD	95% CI	Frequency (%)
Concussion guidelines should be followed at school level	3.00 \pm 1.14	2.9-3.1	Strongly agree: 328 (43) Agree: 282 (37) Not sure: 79 (10) Disagree: 11 (1) Strongly disagree: 61 (8)
Concussions are often not reported	1.57 \pm 1	1.5-1.6	Strongly agree: 89 (12) Agree: 310 (41) Not sure: 227 (30) Disagree: 97 (13) Strongly disagree: 36 (5)
Perceived Seriousness of headache & dizziness after head knock (1 = not serious; 5 = extremely serious)	2.40 \pm 1	2.3-2.4	Not serious: 33 (4) Mildly serious: 106 (14) Moderately serious: 244 (32) Very serious: 269 (36) Extremely serious: 102 (13)
Players shouldn't participate in physical activity with concussion signs & symptoms	1.02 \pm 1	0.9-1.0	Strongly agree: 240 (32) Agree: 353 (47) Not sure: 91 (12) Disagree: 32 (4) Strongly disagree: 37 (5)
It is important to understand how concussion happens	0.73 \pm 0.9	0.6-0.8	Strongly agree: 337 (45) Agree: 325 (43) Not sure: 59 (8) Disagree: 9 (1) Strongly disagree: 23 (3)
It is important to understand concussion prevention	0.67 \pm 0.8	0.6-0.7	Strongly agree: 373 (50) Agree: 293 (40) Not sure: 59 (8) Disagree: 8 (1) Strongly disagree: 20 (3)
It is important to understand what to do if you see a concussion	0.55 \pm 0.8	0.5-0.6	Strongly agree: 436 (58) Agree: 248 (33) Not sure: 41 (5) Disagree: 8 (1) Strongly disagree: 16 (2)
Possible concussion should be reported to medical professional	0.65 \pm 0.8	0.6-0.7	Strongly agree: 366 (49) Agree: 308 (41) Not sure: 52 (7) Disagree: 7 (1) Strongly disagree: 14 (2)
Coaches & referees should be informed of concussion signs & symptoms	0.66 \pm 0.8	0.6-0.7	Strongly agree: 364 (49) Agree: 306 (41) Not sure: 55 (7) Disagree: 14 (2) Strongly disagree: 10 (1)
Players are not well educated about concussion	1.08 \pm 0.9	1.0-1.1	Strongly agree: 199 (27) Agree: 350 (47) Not sure: 146 (19) Disagree: 40 (5) Strongly disagree: 12 (2)

Abbreviations: SD, standard deviation; CI: confidence interval. 1= strongly agree, 5 = strongly disagree

Between Group Comparisons

As seen in the demographics table, rugby was the dominant sport played. Therefore, a chi-squared analysis was undertaken to compare rugby with other sports on a number of key questions.

Table 5: Comparisons between sport type on concussion knowledge items.

Knowledge Items	Rugby N = 447 Frequency (%)	Other Sports N = 359 Frequency (%)	Test of Difference
Heard of concussion? Yes	430 (96.2)	326 (90.8)	$\chi^2 = 9.94, p = 0.002$
Concussion is an injury to the _____ (correct answer brain or head)	433 (96.9)	337 (93.9)	$\chi^2 = 4.19, p = 0.04$
Aware of concussion guidelines	362 (80.9)	132 (36.8)	$\chi^2 = 164.06, p = <0.0001$
Headache (true)	388 (86.8)	286 (79.7)	$\chi^2 = 7.40, p = 0.0007$
Dizziness (true)	369 (82.6)	290 (80.8)	$\chi^2 = 0.42, p = 0.52$
Blurred vision (true)	360 (80.5)	277 (77.2)	$\chi^2 = 1.37, p = 0.24$
Confusion (true)	352 (78.7)	260 (72.4)	$\chi^2 = 4.36, p = 0.04$
Loss of consciousness (true)	296 (66.2)	225 (62.7)	$\chi^2 = 1.09, p = 0.30$
Nausea (true)	243 (54.4)	144(40.1)	$\chi^2 = 16.20, p = <0.00001$
Amnesia (true)	187 (41.8)	129 (35.9)	$\chi^2 = 2.91, p = 0.09$
Insomnia (true)	49 (11)	59 (16.4)	$\chi^2 = 5.14, p = 0.02$
Numbness or tingling of the arms (true)	105 (23.5)	74 (20.6)	$\chi^2 = 6.71, p = 0.009$
A player complains of stinging or burning in his calf muscles (false)	438 (98.0)	339 (94.4)	$\chi^2 = 7.27, p = 0.007$
A team mate is complaining of headaches and blurred vision (true)	307 (68.7)	199 (55.4)	$\chi^2 = 14.96, p = <0.0001$
After a ruck/fall/head clash a player is left on the ground not moving (true)	301 (67.3)	232 (64.6)	$\chi^2 = 0.65, p = 0.42$
After a big knock/fall/head clash the player starts making wrong decisions or actions during the game (true)	296 (66.2)	249 (69.4)	$\chi^2 = 0.90, p = 0.34$
In the team room a couple of hours after the game a team mate complains of feeling sick with a headache (has not been drinking alcohol) (true)	259 (57.9)	227 (63.2)	$\chi^2 = 2.33, p = 0.13$
General knowledge			
Concussion only occurs if you lose consciousness (false)	383 (85.7)	302 (84.1)	$\chi^2 = 0.38, p = 0.54$
If you are experiencing concussion signs & symptoms after a head knock or sudden movement to the body you should not return to play (true)	382 (85.5)	297 (82.7)	$\chi^2 = 1.12, p = 0.29$
Joint problems (false)	426 (95.3)	345 (96.1)	$\chi^2 = 0.31, p = 0.58$
No complications exist (false)	417 (93.3)	276 (76.9)	$\chi^2 = 44.47, p = <0.0001$
Brain damage (true)	341 (76.3)	241 (67.1)	$\chi^2 = 8.32, p = 0.004$
Memory problems (true)	292 (65.3)	206 (57.4)	$\chi^2 = 5.32, p = 0.21$
Increased symptoms (true)	191 (42.7)	127 (35.4)	$\chi^2 = 4.51, p = 0.03$
Increased risk of further injury (true)	170 (37.9)	136 (37.9)	$\chi^2 = 0.0019, p = 0.97$
≥3 weeks or when fully recovered	364 (81.4)	176 (49)	$\chi^2 = 94.57, p = <0.00001$
Going to sleep (false)			
Doctor (true)	392 (87.7)	309 (86.1)	$\chi^2 = 0.46, p = 0.50$

*Values considered significant at $P < 0.01$ level to account for multiple comparisons

Table 6: Comparisons between sport type on attitude items.

Scored from a scale of 5 (strongly agree) to 1 (strongly disagree)	Rugby Mean \pm	Other Sports Mean \pm	Test of Difference
Concussion guidelines should be followed at school level	4.20 \pm 1.12	3.87 \pm 1.15	t=3.98, p=<0.0001
Concussions are often not reported	3.46 \pm 1.08	3.36 \pm 0.91	t=1.49, p=0.14
Seriousness of headache & dizziness after head knock (1 = not serious; 5 = extremely serious)	3.45 \pm 1.02	3.34 \pm 1.03	t=1.45, p=0.15
It is important to understand what to do if you see a concussion	4.47 \pm 0.80	4.41 \pm 0.86	t=0.98, p=0.32
Possible concussion should be reported to medical professional	4.37 \pm 0.82	4.31 \pm 0.79	t=0.98, p=0.33
Coaches & referees should be informed of concussion signs & symptoms	4.37 \pm 0.76	4.29 \pm 0.85	t=1.34, p=0.18
Players are not well educated about concussion	3.86 \pm 0.94	3.99 \pm 0.84	t=-2.00, p=0.05

**Values considered significant at P<0.01 level to account for multiple comparisons*

Rugby players were significantly more aware of concussion guidelines (p<0.001) than other sports, that a minimum three week stand down is required (p<0.001) and that guidelines should be followed at school level (p<0.001). These differences may reflect the greater amount of education and use of the blue card seen in rugby compared to other codes.

DISCUSSION

The results from the *Secondary School Student 2017 Survey* suggest that students are knowledgeable regarding concussion and appear to show positive attitudes towards correct management of the injury. There was a general consensus from the students that they wanted to know more about how concussion happens, prevention and effective management. Almost one third of the students who participated in the survey reported experiencing a previous concussion. The majority of information on the awareness and management of concussion is coming from schools, teachers and coaches, and medical professionals with some from sports clubs and ACC. An increase in the awareness of the ACC Guidelines and why these are important to follow is warranted in this group. Some specific gaps in knowledge in terms of onset of symptoms, activities to avoid post-concussion, possible complications of multiple injuries and recognition of amnesia, nausea, trouble sleeping as symptoms of concussion were identified.

Knowledge of concussion

Participants demonstrated the ability to identify common signs and symptoms after a concussion. Blurred vision, confusion, dizziness, headache and loss of consciousness were well recognised by many participants, however a gap in knowledge for most participants was apparent with symptoms that are less obvious, less prevalent and receive less advertisement by mainstream media sources (Sullivan et al., 2011). "Amnesia", "insomnia" and "nausea" were omitted by 60%, 86% and 51% respectively, indicating a lack of awareness of these resultant symptoms. It remains unclear as to whether this finding reflects a lack of knowledge about the links between the specific symptom and concussion or whether these findings reflect a lack of understanding of these more technical terms used to describe the symptoms. For example, terms such as insomnia and nausea may need different use of language with students such as "problems sleeping" and "feeling sick" respectively.

There were good levels of awareness when participants were asked about which activities should be avoided following a concussion with regards to physical exertion, however the negative impact of using technology which can over-stimulate a recovering brain—such as texting, Facebook and school

work—were very poorly acknowledged (39%, 38%, 32% respectively). These two areas indicate that students are unaware of the impact cognitive exertion can have on recovery after a concussion, and information on “cognitive rest” has not been provided. Cognitive activity imposes additional neurometabolic demand on the brain, and an exacerbation of symptoms can indicate that the recovering brain is operating beyond its limits (McLeod et al., 2010). According to McLeod (2010), cognitive rest can be defined as avoiding excessive cognitive activity in the early post-concussion stage, such as using a computer, texting, watching television or schoolwork. This indicates that greater information provision is needed in this area.

In addition to these cognitive symptoms, “numbness or tingling of the arms” was only attributed to concussion by 22% (numbness is among the least frequently experienced symptoms). Bleeding from various facial orifices was correctly believed not to be a symptom of concussion by many participants, with only 20% selecting “bleeding from the ear” as correct. This may indicate that participants had good ability to isolate the brain injury from other facial trauma that may occur simultaneously, and when compared to high school athletes in the United States, this sample demonstrated similar knowledge level in this area (Register-Mihalik et al., 2013).

Participants were able to apply their concussion knowledge of signs and symptoms practically, and identified scenarios illustrating a player with concussion to a good level. The concussion symptoms exhibited in the scenarios were impaired decision-making, headache, blurred vision, loss of consciousness and nausea, and were correctly identified by approximately 60-70 percent of participants in each hypothetical situation. Although they were able to recognise loss of consciousness as a possible indication of concussion, 85% also realised that this does not determine a concussion. It therefore appears that some students are able to recognise a player demonstrating the classic presentation of concussion. However, further education is required for the remaining 30 -40%. Additionally, students were less able (50%) to spot the possible impact of concussion in the scenario when there was a delayed onset of symptoms. They were also relatively unaware of the negative impact on performance (47%) which may be a useful message to highlight in education programmes.

It was disappointing to see that overall only 35% of the students could identify the mandatory three-week stand-down period implemented by rugby union, and that waiting until all the symptoms had resolved was important. However, the sub-analysis of the rugby cohort (see Table 5) indicated a much higher level of awareness of rugby players (81%) recognising the mandatory stand down compared with 49% of the other codes. This indicates that rugby is doing more in concussion education. This is an improvement since the finding of the study by Sye et al. (2006), where 52% of participants in that study made their own decision on when to return to sport and only 22% after medical clearance. However, students should still be further educated on why returning to sport too soon may be detrimental to long-term health, which should subsequently result in a reduction in serious associated conditions such as post-concussion syndrome and secondary impact syndrome.

Attitudes towards concussion

Overall the students have a very positive attitude to the management of concussion and recognise the importance of following the guidelines and recognising symptoms. They also have strong views that concussion is not well managed, and symptoms are often not reported. Fifty percent agreed that concussion was often not reported which is similar to the number of secondary students who reported hiding or downplaying sports injuries in another recent survey (Whatman et al., 2018). They do recognise that symptoms need to be reported to medical professionals but also that coaches and referees equally need to be informed when players have symptoms. These results are similar to the findings of Register Mikhalik et al. (2013), who found that high school athletes had good attitudes to the recognition and management of concussion and the symptoms.

Methods bias

It is noted that those with good KA of concussion may be more likely to want to participate in the study. Another limitation of the study is that other sports with high concussion rates such as cycling and equestrian events were not in the survey sample.

CONCLUSIONS

The results from the *Secondary School Student 2017 Survey* suggest that these 807 students are relatively knowledgeable regarding concussion and appear to show positive attitudes towards correct management of the injury. There is a general consensus that further education for secondary school students is required to optimise management and improve the awareness of concussion. Almost 35% of participants reported experiencing a previous concussion. Gaps in knowledge of concussion included: the ability to understand what amnesia was; the fact that insomnia, amnesia and nausea are common symptoms, which players may experience increasing symptoms over time; and that text message and similar activities that require cognitive function may need to be avoided until symptoms have settled. Only 35% of participants understood the need for stand down periods and when to return to sport once symptoms have fully resolved.

Recommendations

- Further education is required to increase understanding of some of the symptoms of sports concussion including amnesia, nausea and insomnia. Changes to simpler terms (e.g. difficulty remembering things, feeling sick and problems sleeping) in the ACC guidelines and educational material, and in the ACC KA surveys, may be needed to ensure students understand what the terms mean.
- Further education is needed with regards to the fact that onset of symptoms of concussion may not be evident immediately following injury and can emerge up to several days following injury.
- Further education is needed regarding the time frames to return to sport – noting that the physiology of the brain is the same no matter what the sport, but that different sports have different international organisations that differ on their views. Hence it is recommended that the NZ ACC guidelines be used as the minimum time frame for return to sport.
- Further education and research is required regarding the potential impacts of multiple concussions.
- Further education and research is required regarding avoiding the use of devices that may affect cognitive function after concussion.
- Further education is required regarding how helmet use does not reduce the risk of concussion and may increase the risk due to change in athlete behaviour.
- Sports clubs may need to take a more active role in sports concussion education given rates of information provision from them was reported to be low. Sports clubs are able to be more proactive than health professionals who students see only after an injury has occurred.
- Continuing education programmes are required to ensure the current overall high levels of knowledge in the student group remain high. Schools and medical professionals are key but ACC visibility can improve.
- Awareness of the ACC Guidelines can be further increased.
- Knowledge changes over time need to be measured to assess the effectiveness of ACC (and other groups) concussion strategies.

REFERENCES

- Murphy, K., Starkey, N., & Theadom, A. (2015). *What do secondary school rugby players think about concussion?* Unpublished Master's Thesis, University of Waikato.
- Register-Mihalik, J. K., Guskiewicz, K. M., Valovich McLeod, T. C., Linnan, L. A., Mueller, F. O., & Marshall, S. W. (2013). Knowledge, attitude, and concussion-reporting behaviours among high school athletes: a preliminary study. *Journal of Athletic Training, 48*(5), 645-653. doi:10.4085/1062-6050-48.3.20.
- Register-Mihalik, J., Linnan, L., Marshall, S., Valovich, K., McLeod, T., Mueller, F., & Guskiewicz, K. (2013). Using theory to understand high school aged athletes' intentions to report sport-related concussion: Implications for concussion education initiatives. *Brain Injury, 27*(7-8), 878-886.
- Reid, D., Hume, P. A., Theadom, A., Whatman, C., & Walters, S. (2017). *Knowledge and attitudes (KA) surveys on concussion in sport. Report to Accident Compensation Corporation.* SPRINZ, Auckland University of Technology.
- Sullivan, J., Collins, K., Grey, A., & Handcock, P. (2016). Blue card: referees' perspectives of a rugby union concussion recognition and management programme. *British Journal of Sports Medicine, 51*(11), 80. doi: 10.1136/bjsports-2016-097270.206
- Sport Concussion in New Zealand: *ACC National Guidelines. Accident Compensation Corporation 2015* www.acc.co.nz.
- Sye, G., O'Sullivan, J. & McCrory, P. (2006). High school rugby players' understanding of concussion and return to play guidelines. *British Journal of Sports Medicine, 40*, 1003-1005.
- Stoller, J., Carson, J., Libfeld, A., Snow, C., Law, M., & Frémont, P. (2014). Do family physicians, emergency department physicians, and pediatricians give consistent sport-related concussion management advice? *Canadian Family Physician, 60*(6), 548-552
- Theadom, A., Starkey, N., Dowell, T. et al. (2014). Sports-related brain injury in the general population: An epidemiological study. *Journal of Science and Medicine in Sport, 17*(1), 591-596. doi:10.1016/j.jsams.2014.02.001
- Whatman, C., Walters, S., & Schluter, P. (2018). Coach and player attitudes to injury in youth sport. *Physical Therapy in Sport In Press*.