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KNOWLEDGE ATTITUDES AND BEHAVIOURS (KAB) SURVEYS ON CONCUSSION IN SPORTS: COACHES SEPTEMBER 2018 SURVEY

REPORT #3TO ACCIDENT COMPENSATION CORPORATION (ACC)

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OVERVIEW

The purpose of the study was to compare the knowledge attitudes and behaviours of a group of New Zealand Secondary School Coaches to sports related concussion (SRC) in conjunction with a social media intervention from the Accident Compensation Corporation (ACC). This report is the third report in a series presenting the changes in Knowledge Attitudes and Behaviours (KAB) around concussion in sport.

The 'Sports Concussion in New Zealand ACC National Guideline' was released in 2014. The KAB studies aim to assess current knowledge and attitudes of secondary school sports students, equestrian riders, parents, coaches, referees, and health professional towards concussion in sport following release of the guideline and to see if the social media campaign from ACC had an impact on KAB.

The results from the *Secondary School Coaches September 2018 Survey* suggest that the 35 coaches in this sample were knowledgeable regarding concussion and show positive attitudes towards correct management of the injury. However, there is need to provide further information on signs and symptoms of concussion and the use of blue screen devices during the recovery period. The majority understood medical clearance was required before return to sport, but a large percentage (46%) still felt that head gear could prevent concussion. A large percentage gained knowledge of concussion management from medical professionals (94%) and a higher percentage than other surveyed groups (42%) were aware of the ACC Concussion Guidelines.

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 KAB surveys, may be needed to ensure coaches understand what the terms mean.
- 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 NZ the current ACC guidelines should be used as the minimum time frame for return to sport.
- Further education 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 the risk due to change in athlete behaviour.
- Coaches have good knowledge and are influential in sports and therefore may need to take a more active role in sports concussion education Coaches working with sports clubs could 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 given by coaches to student groups remains high
- 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 KAB concussion research programme are to undertake surveys of secondary school students, coaches, parents, referees, equestrian riders and health professionals to understand their current knowledge and attitudes towards the management of sports related concussion. This report overviews the findings from coaches of secondary school students.

The key outcomes of this review are:

- **A comprehensive overview of the KAB of sports related concussion in secondary school coaches, after the implementation of the ACC Sports Concussion Guidelines and the Social Media Campaign 2018.**
- **Recommendations of the key areas where improvements can be made to improve KAB of sports related 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 did not 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.

Coaches are often the first point of contact to assess sport-related concussions in sport teams and have an influence over the behaviours of players (O'Donaghue et al 2009). There has been a number of studies that have investigated the knowledge of sports related concussion in coaches (White et al 2014, McLeod et al 2007, Mrazick et al 2011 and O'Donaghue et al 2009). All of these studies have found variation in the levels of knowledge and application of guidelines to the players they coach. At this time, there is little known about the level of knowledge and behaviours of NZ secondary school coaches.

Purpose

The purpose of this report is to present the results of the *Coaches September 2018 Survey* in relation to their knowledge, attitudes and behaviours around sports-related concussion guidelines and management for secondary school players who may have been concussed under their care.

METHODOLOGY

Data collection process

The *Secondary School Coaches September 2018 Survey* was undertaken in the months of September to December in the areas outlined in Table 1.

Table 1: Secondary School Coaches September 2018 Survey areas and sports.

Event	Sport	Venue and date	Projected numbers
National Secondary Schools Tournament	Rugby League	Bruce Pulman Park, Auckland, September 3rd -7th Sept 2018	528
Jock Hobbs U19s Tournament	Rugby	Taupo, September 8th–15th 2018	400
Schick Premierships AA Zone 2	Basketball	Rotorua Events Centre September 5-7th 2018	330
AA Secondary Schools Premierships Zone 2	Basketball	Tauranga, September 5th–8th 2018	370

Harbour - Schick Premierships AA Zone 1	Basketball	North Shore Events Centre September 5th– 8th 2018	370
Schick Northern Cup	Basketball	Bruce Pullman Park Papakura, September 5- 7th 2018	250
NZ Secondary School Champs	Netball	Blake Park Maunganui Road. Mt Maunganui 3rd to 6th Sept	1488
National Age Groups Tournament.	Football Random sample	Wellington December 10th-15th	47
Total			**3756**
Completed surveys			1347
Response rate			**35%**

The methodology used to ascertain the Knowledge Attitudes and Behaviours (KAB) 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. (2013a, 2013b). Four additional questions on behaviours towards SRC were added to the 2018 survey that were not included in the 2017 survey. Ethical approval was provided by AUTEC Application # **16/187.** The ACC Ethics Committee also approved the study.

Participants and their recruitment

Participants were 16 years of age or older, and coach secondary school sports teams. The sample was one of convenience from coaches attending the above tournaments and willing to complete the survey. In 2017 the KAB surveys targeted referees but not coaches so a greater effort was made in 2018 to capture the KABs of this group. A sample of 35 coaches completed the surveys.

Intervention

Between the 2017 and 2018 data collection points for the KAB study, ACC delivered a social media campaign to all school students, parents and coaches attending tournament week (3-7 September 2018). This coincided with the same week as the KAB data collection at the tournaments listed in Table 1. There was one post via the ACC SportSmart Facebook page each day of the tournament on a different aspect of concussion management. 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://accsportsmart.co.nz/concussion/

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

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. There was no attempt to investigate between group comparisons for key variables as this was a one-off data collection point.

RESULTS

Participants

Table 2 details the demographic characteristics of the participants who completed the survey. The mean age of coaches was 32 years (SD:11.3), with a slightly higher percentage of female coaches (54%). New Zealand Pakeha (54%) and Maori (49%) were the most common ethnicities identified. Basketball (57%) was the most common sport coached followed by Netball (34%). Sixty percent of coaches had been coaching for more than five years and the majority at school level (51%). Thirty seven percent had a personal history of concussion.

Table 2: Demographics of the 35 secondary school Coaches who completed the *Coaches 2018 Survey*

Demographic characteristic	**Mean (SD) or (frequency %)**
Age	Mean 32 (SD 11.3) (95% CI 29.1, 36.8)
Gender	Male 16(45.7) Female 19(54.3)
Ethnicity	New Zealand Pakeha 19 (54.3) Māori 17 (48.6) Pacific Islands 4(11.4) Asian 1 (2.9) Other 2 (5.7)
Main sport coached	Rugby Union 3 (8.6) Rugby League 3 (8.6) Netball 12 (34.3) Basketball 20 (57.1) Football 2 (5.7)
Highest level coached	Club 3(8.6) School 18 (51.4) Regional 10(28.6) National 6 (17.1)
Number of years coaching	1 year 4(11.4) 2 years 5 (14.3) 3 years 2(5.7) 4 years 41.4) 5 years 21 (60)
Personal history of concussion	Yes 13(37.1 No 19 (54.3)

Knowledge of concussion

Table 3 consists of the responses for the 20 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 97% of participants. The most common symptoms identified were blurred vision (94%), confusion (85%) dizziness (86%) headache (87%) and loss of consciousness (75%). Amnesia (60%) and nausea (60%) were less well recognised symptoms. Ninety four percent of coaches gained concussion information from a medical professional and ACC guidelines were known by 43%.

Regarding decision-making related to returning to training and games after a concussion, a doctor was correctly identified by 94% of participants as the most competent person to judge when a player was ready to return to sport.

A large percentage of respondents believed that head gear prevented concussion (46%) and only 51% recognised the use of 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. The majority of respondents felt it was safe to return to play after 4 weeks (94%) and 65% only when symptoms have resolved

Table 3: Knowledge of concussion of the 35 secondary school coaches who completed the *Coaches 2018 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:	
Abnormal sense of smell (false)	30 (85.7)
Abnormal sense of taste (false)	30 (85.7)
Amnesia (true)	21 (60)
Joint stiffness (false)	30 (85.7)
Blurred vision (true)	33 (94.3)
Black eye (false)	29 (82.9)
Bleeding from the ear (false)	25 (71.4)
Bleeding from the mouth (false)	30 (85.7)
Bleeding from the nose (false)	24 (68.6)
Confusion (true)	30 (85.7)
Fever (false)	31 (88.6)
Dizziness (true)	30 (85.7)
Headache (true)	31 (88.6)
Insomnia (true)	9 (25.7)
Loss of consciousness (true)	26 (74.3)
Nausea (true)	21 (60)
Numbness or tingling of the arms (true)	27 (77.1)
Skin rash (false)	35 (100)
Sharp burning pain in neck (false)	17 (77.1)
Weakness in neck movements (false)	21 (60)
Which of the following players would you say might be “concussed”?	
After a big knock/fall/head clash the player starts making wrong decisions or actions during the game (true)	28 (80)
A team mate is complaining of headaches and blurred vision (true)	28 (80)
After a ruck/fall/head clash a player is left on the ground not moving (true)	31 (88.6)
A player complains of stinging or burning in his calf muscles (false)	34 (97.1)
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)	22 (62.9)

General knowledge	
Concussion is an injury to the __ (correct answer brain)	34 (97.1)
Concussion only occurs if you lose consciousness (false)	32 (91.4)
If you are experiencing concussion signs & symptoms after a head knock or sudden movement to the body you should not return to play (true)	30 (85.7)
What are the possible complications of multiple concussions?	
No complications exist (false)	35(100)
Increased symptoms (true)	23 (65.7)
Increased risk of further injury (true)	21 (60)
Brain damage (true)	31 (88.6)
Memory problems (true)	31 (88.6)
Joint problems (false)	35 (100)
Unsure of answer (false/not selected)	35 (100)
What are the possible complications of returning to play too soon?	
No complications exist (false)	35 (100)
Increased risk of further injury (true)	32 (91.4)
Paralysis (false)	29 (82.9)
Brain damage (true)	26 (74.3)
Reduced sports performance (true)	21 (60)
Joint Problems (false)	32 (91.4)
If a player gets concussed, how long should they wait before returning to training or games?	
Get straight back on (false)	35 (100)
1 week (false)	35 (100)
2 weeks (false)	33 (94.3)
3 weeks (true)	28 (80)
4 weeks (true)	33 (94.3)
When the symptoms have fully resolved (true)	23 (65.7)
What does headgear prevent?	
Cuts & grazes (true)	24 (68.6)
Cauliflower ears (true)	20 (57.1)
Concussion (false)	19 (54.3)
Neck injury (false)	34 (97.1)
Skull fracture (false)	21 (60)

Unsure of answer (false/not selected)	3 ((8.6)
Which activities should be avoided following a concussion?	
Texting (true)	18 (51.4)
Facebook (true)	18 (51.4)
TV (false)	21 (60)
Long walks (true)	7 (20)
Jogging (true)	23 (65.7)
Gym training (true)	25 (71.4)
School work (true)	12 (34.3)
Going to sleep (false)	23 (65.7)

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" (73%) that guidelines should be followed at school level. A similar percentage (73%) agreed that students needed further education around concussion and that coaches and referees should be informed around concussion signs and symptoms (85%). A high percentage strongly agreed that concussion is often not reported (74%).

Table 4: Attitudes towards concussion of the 35 secondary school coaches who completed the *Coach 2018 Survey*

Scored from a scale of 1 (strongly agree) to 5 (strongly disagree)	**Frequency (%) 2018**
Concussion guidelines should be followed	Strongly agree: 17 (48.6) Agree: 9 (25.7)
Concussions are often not reported	Strongly agree: 26 (74.3) Agree: 15 (42.9) Not sure: 4 (11.2) Disagree: 5 (14.3) Strongly disagree: 1 (2.9)

Seriousness of headache & dizziness after head knock (1 = not serious; 5 = extremely serious)	Mildly serious: no 35 (100) Moderately serious: 4 (11.4) Very serious: 12 (34.3) Extremely serious 10 (28.6)
Players shouldn't participate in physical activity with concussion signs & symptoms	Strongly agree: 21(60) Agree: 10 (28.6) Disagree: 1 (2.9)
It is important to understand how concussion happens	Strongly agree: 25 (71.4) Agree: 7 (20)
It is important to understand concussion prevention	Strongly agree: 19 (54.3) Agree: 13 (37.1)
It is important to understand what to do if you see a concussion	Strongly agree: 21 (60) Agree: 10 (28.6)
Possible concussion should be reported to medical professional	Strongly agree: 24 (68.6) Agree: 7(20)
Coaches & referees should be informed of concussion signs & symptoms	Strongly agree: 24 (68.6) Agree: 6 (17.1)
Players are not well educated about concussion	Strongly agree: 16 (45.7) Agree: 10(28.6) Not sure: 2 (5.7) Disagree: 5 (14.3)

Behaviour items

There were four additional questions in the 2018 survey that asked about behaviours of players coaches and referees with respect to the on-field management on 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. See 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 (37%) stated this sometimes happened and 34% stated this rarely or never happened. It was rare or never happened (60%) that coaches and referees encouraged players to keep playing. Sixty percent 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 but there is still approximately 40% that are sometimes observing these behaviours.

Table 5: Behaviours towards concussion of the 35 secondary school coaches who completed the *Coach 2018 Survey*

Scored from a scale of 1 (often) to 4 (never)	**Frequency (%) 2018**
Have you seen players playing on with a suspected concussion when you thought they should not have?	Very Often 3 (8.6) Often 6(17.1) Sometimes 13 (37.1) Rarely 6 (17.1) Never 6 (17.1)
Have you seen coaches allowing players to play on with a suspected concussion?	Very Often 1 (2.9) Often 3(8.6) Sometimes 8 (22.9) Rarely 9 (25.7) Never 12 (34.3)
Have you seen referees/umpires allowing players to play on with a suspected concussion?	Very Often 35 (100) Often 2(5.7) Sometimes 4 (11.4) Rarely 10 (28.6) Never 17(48.6)
Have you seen players putting pressure on other players to play on with a suspected concussion?	Very Often 1(2.9) Often 3(8.6) Sometimes 8 (22.9) Rarely 4 (11.4) Never 17 (48.6)

DISCUSSION

The main findings of the *Secondary School Coach 2018 Survey* suggest coaches are knowledgeable regarding concussion and appear to show positive attitudes and behaviours towards correct management of the injury. There was a general consensus from the respondents that they wanted to know more about how concussion happens, prevention and effective management. The majority of information on the awareness and management of concussion is coming from medical professionals and ACC. This group more than any others surveyed had a greater awareness of the ACC Guidelines and why these are important to follow. Some specific gaps in knowledge in terms of onset of symptoms, activities to avoid post-concussion, use of head gear, possible complications of multiple injuries and recognition of amnesia, nausea, trouble sleeping as symptoms of concussion still remain.

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. These signs and symptoms were at higher percentages than those surveyed by McLeod et al (2007) who found that only 60% of coaches recognised these key symptoms. 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 40%, 75% and 40% 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 coaches 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 awareness of the negative impact of using technology which can over-stimulate a recovering brain was low—such as texting, Facebook and school work—at 51%, 51% and 34% respectively. These areas indicate that coaches are still 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 & Gioia, 2010). According to McLeod and Gioia

(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 further information provision is needed in this area.

Bleeding from various facial orifices was correctly believed not to be a symptom of concussion by many participants and recognised as incorrect by 70-80% of respondents. 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, 2013a).

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 80 -90% of participants in each hypothetical situation. Although they were able to recognise loss of consciousness as a possible indication of concussion, 91 % also realised that this does not determine a concussion. This is a higher percentage than coaches in a study by McLeod et al (2007) where only 42% of respondents recognised that your do not need to lose consciousness to be concussed. It therefore appears nearly all participants were able to recognise a player demonstrating the classic presentation of concussion. However, coaches were less able (60%) to spot the possible impact of concussion in the scenario when there was a delayed onset of symptoms. The awareness that concussion has a negative effect on performance was recognised by 60% but this message still requires further highlighting in education programmes. A large percentage (46 %) also believe that head gear can prevent concussion. This is an area that requires significant education in the future.

Attitudes towards concussion

Overall the coaches 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. Seventy four percent agreed that concussion was often not reported which is similar to the number of secondary school players 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 Mrazick et al (2011) who found that coaches had good attitudes to the recognition and management of concussion and the symptoms.

Behaviour items

In the 2018 survey, four additional questions were included that specifically asked about player, coach and referee behaviours when dealing with players that might have been concussed. Overall it was rare to see pressure being put on players to continue to play on with concussion but there was a small percentage that sometimes observed these behaviours (22%). This is an area were further coach education could influence player behaviour.

Methods bias

It is noted that those with good KA of concussion may be more likely to want to participate in the study.

CONCLUSION

The results from the *Secondary School Coach 2018 Survey* suggest these coaches are knowledgeable regarding concussion and appear to show positive attitudes and behaviours towards correct management of the injury. There is a general consensus that further education for secondary school coaches is required to optimise management and improve the awareness of 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. Sixty five percent of participants understood that players should not to return to sport until 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 KAB surveys, may be needed to ensure coaches understand what the terms mean.
- 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 NZ the current ACC guidelines should be used as the minimum time frame for return to sport.
- Further education 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 the risk due to change in athlete behaviour.
- Coaches have good knowledge and are influential in sports and therefore may need to take a more active role in sports concussion education. Coaches working with sports clubs could 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 given by coaches to student group remain high
- 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

McLeod, T and Gioia, G. (2010) Cognitive Rest: The Often-Neglected Aspect of Concussion Management. Athletic Therapy Today. Human Kinetics - ATT 15(2), pp. 1-3

McLeod, T, Swartz, C and Bay, R (2007) Sport-Related Concussion Misunderstandings Among Youth Coaches Clin J Sport Med;17:140–142.

Mrazick, M, Bawani, F and Krol, A. (2011) Sport-Related Concussions: Knowledge Translation Among Minor Hockey Coaches Clin J Sport Med; 21:315–319

Murphy, K., Starkey, N., & Theadom, A. (2015). *What do secondary school rugby players think about concussion?* Unpublished Master's Thesis, University of Waikato.

Pickup K, Starkey N, & Theadom A. (2015) *What do secondary school rugby players think about concussion?* Unpublished Master's Thesis, University of Waikato.

O'Donoghue, E, Onate J, Van Lunen, B and Peterson, C. (2009) Assessment of High School Coaches' Knowledge of Sport-Related Concussions Athletic Training and Sports Health Care.;1(3):120-132

Register-Mihalik, J. K., Guskiewicz, K. M., Valovich McLeod, T. C., Linnan, L. A., Mueller, F. O., & Marshall, S. W. (2013a). 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. (2013b). 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.

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., 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.

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*.

White, PE, Newton, JD, Makdissi, M. et al. Br J Sports Med (2014) Knowledge about sports-related concussion: is the message getting through to coaches and trainers? 48:119–124.