What Do Secondary School Rugby Players Think About Concussion?

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Abstract

Traumatic Brain Injury (TBI) is a dominant and growing public health concern globally. Sport is an arena in which people are at high risk of TBI. In New Zealand the popular sport of rugby is played by many, particularly during school years. These school aged players are at particular risk of TBI because of the contact nature of the sport and the maturational stage of the brain which is still developing during the teenage years. Moves to increase safety depend on an awareness of what these players know about TBI and their attitude towards TBI.

A sample of 456 secondary school rugby players in New Zealand were surveyed to gather information about their knowledge of, and attitude towards concussion. Rugby union and rugby league playing participants were mainly recruited through direct contact with schools. Participants were invited to access the survey online or could complete a paper copy. The survey was made up of items which had already been used in previous studies and this allowed for a comparison of findings with previous research. Some items related to knowledge of concussion while others related to attitude towards concussion, in particular attitudes to returning to play following concussion.

Participants had good knowledge of symptoms, and almost all participants knew there was a risk to long term health and a risk of death if a second concussion was sustained before a first concussion had healed. However, there were some gaps in knowledge about treatment and recovery time.

Participants self-reported attitudes to concussion were consistently and significantly safer than the attitudes they predicted 'most players' would hold. More than half of the participants had a relatively safe attitude to all but one of the items relating to concussion attitude. The least safe attitudes were around who

should make a decision to returning to play after concussion and the safety of attitudes declined as the importance of a rugby match increased.

Ethnicity consistently influenced knowledge and attitude on all the measures used within the survey. Those identifying as Māori ethnicity scored lower on all knowledge and attitude scales than those identifying as Pakeha ethnicity. Self-rated knowledge of concussion and the number of concussions experienced also had a positive effect on knowledge of concussion.

There are several educational tools and regulatory documents aimed at minimising the incidence, severity and outcome of concussion in rugby but there is little research guiding how these resources are tailored to their intended audience in the secondary school population. Also, little is known about the gaps in knowledge and understanding of concussion in this population. It is tentatively stated that the findings from this study could be used to inform strategies which are aimed at increasing knowledge and making attitudes safer in secondary school rugby players in New Zealand.

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Chapter One: Introduction

What is traumatic brain injury (TBI)?

TBI is most widely defined as 'an acute brain injury resulting from mechanical injury to the head from external physical forces' (Carroll, Cassidy, Holm, Kraus & Coronado, 2004, p. 115). The term TBI encompasses injuries which are often described using different terminology including brain injury, head injury, head knock, and concussion. Injuries can vary in severity and are predominantly measured by post injury evaluation scales including the Glasgow Coma Scale (Teasdale & Jennet, 1974) and the assessment of Post Traumatic Amnesia (Marshman, Jakabek, Hennessy, Quirk, & Guazzo, 2013). These evaluations lead to a classification of Mild, Moderate or Severe TBI.

This Master's thesis is about TBI of all severity. It will explore the status of TBI internationally and its incidence in sport, finally focusing on New Zealand where it will analyse results of a survey to measure secondary school rugby players' knowledge of TBI and attitudes towards TBI.

Worldwide Incidence of TBI

Globally, it is estimated that 10 million people are affected by TBI each year (Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye, 2007). Research has highlighted TBI as one of the main causes of chronic disability in children and adults under 35-years (Hyder et al, 2007; Langlois, Rutland-Brown & Wald 2006). Not only does TBI have consequences for the person who sustained the injury, it also impacts on those close by including family, friends and society in general (Donders & Warschausky, 2007; von Holst, 2007; Mock, Quanash, Krishnan, Arreola-Risa & Rivara, 2004). Parents can grieve for the

child they knew before the TBI, they can experience elevated confusion, sadness and isolation and have elevated stress throughout the family because of the extra demands of caring for a family member with TBI (Roscigno & Swanson, 2011). Societal costs include medical expenses for assessment, treatment and rehabilitation of those experiencing TBI (Humphreys, Wood, Phillips & Macy, 2013).

Incidence of TBI is expected to rise (The Lancet Neurology, 2010), with projections that by 2020 TBI will be the third largest cause of global disease burden (The Lancet Neurology, 2010). Von Holst (2007) forecasts that increased leisure time and expansion of the leisure industry will mean increased participation in leisure activities which will result in more people suffering TBI. Yet despite these figures suggesting that TBI has become a significant public health problem, it is likely to be the case that these worldwide statistics are underestimates of the scope of the problem. One reason for this is that data is gathered using varying data collection methods. Additionally, many developing countries have no systems to record TBI incidence and therefore TBI in these countries goes largely unreported (von Holst, 2007). TBI incidence is likely to be higher in developing countries for many reasons including increasing violence due to political unrest in low and middle income countries, a high frequency of falls or accidents because of low public health and safety standards and a high incidence of road traffic accidents because of inadequate safety regulation of road traffic (Hyder et al. 2007). Furthermore, incidence figures are often based on official records such as hospital visits which only capture those who seek hospital treatment. Many do not seek hospital treatment because they live rurally and a long way from medical services (Hyder et al. 2007). Living in poverty may mean

a lack of resources to travel to access medical help so that many people with TBI die before reaching hospital (Hyder et al. 2007).

Financial Costs of TBI

With TBI comes a cost which can be categorised in two ways; the financial cost and the human cost. Like comparisons of incidence, the various estimates of costs are difficult to compare because of differing categorisation of costs, and varying evaluation techniques and research methodologies (Humphreys et al., 2013). Reviewing several cost analysis research articles McGregor and Pentland (1997) found that during the 1990s in the UK, the direct cost of mild and moderate TBI was between GBP£28,300 and GBP£59,600 per patient. During a 4 year period from 2001, total direct costs of all categories of TBI were estimated at USD$95 million per year in one state, Missouri, in America, and loss of productivity costs nationally were USD$1.1 billion (Kayani, Homan, Yun & Zhu, 2009). Across the whole of America, the Centers for Disease Control and Prevention (CDC) estimated total combined direct and indirect costs in excess of USD$76.5 billion annually.

TBI is common in young people and the financial cost of TBI in children is different from adults as there are variations in developmental stage, injury, sequelae, recovery and outcomes. Factors such as income and loss of productivity do not feature as predominantly until later in life during adulthood. The US Healthcare Cost and Utilization Project Kids' Inpatient Database found 50,658 children and adolescents were hospitalised for TBI related injury in 2000 at a cost of over USD$1 billion for acute hospital care (Rockhill, Fann, Fan, Hollingworth & Katon, 2010). By 2006 this admission figure had reached 58,900 and total hospital care costs were calculated at USD $2.56 billion (Shi et al., 2009).

Rockhill et al. (2010) focused on evaluating the cost of healthcare across a 3 year post injury period for a group of US adolescents under 15 years who had a mild TBI (mTBI) diagnosis. This study involved the mTBI group and a matched non mTBI / non-injured group. As expected the mTBI patients incurred substantially more healthcare costs than the control group.

In New Zealand, the financial burden of TBI has also been found to be significant. Over a 10 year period from 2001 onwards New Zealand's Accident Compensation Corporation (ACC) (www.acc.co.nz) which provides tax payer funded no fault personal injury cover for residents and visitors, accepted 20,902 sport related concussion claims which cost $NZD 16,546,026. (King, Gissane, Brughelli, Hume & Harawira, 2014).

More recently ACC reported 16,639 active claims for TBI during the 12 month period from July 2013 (www.acc.co.nz). During the same period ACC reported paying out $71,766,598.00 for new and existing TBI claims. Of this amount, $19,656,272.00 was for those aged 19 years and under (www.acc.co.nz). One recent study has estimated the costs of TBI in New Zealand using a complex and comprehensive analysis (Te Ao et al., 2014). All TBI sustained during a one year period in the Waikato region of New Zealand were included in the study. TBI cases were sourced through a widespread data collection process which included hospitalised cases and non-hospitalised cases of all ages and all severity of TBI. Cost analysis was based on direct and indirect health care expenses, out of pocket expenses and productivity loss.

Human Costs of TBI

As well as the financial implications of TBI, the impact on many aspects of life can also be significant. TBI can effect cognition, physical function,

behaviour (Anderson et al., 2001), memory, attention span (Grady, 2010), interpersonal function (Babikian & Asarnow, 2009) and mental health status (Rockhill et al., 2010). Even following a mild TBI the effects can be significant and persistent (Theadom et al. in press).

Outcomes of TBI are different in adults and children, partly because of the difference in the maturational state of the brain and the developmental stage of the child. Whilst research in adults has increased rapidly over the last decade, less is known about children. It is difficult to predict the outcome of TBI in children as there are so many biological and environmental factors interacting and impacting to shape the severity and duration of impairment (Anderson, 2001). However, most children who sustain TBI, particularly mTBI make a good, full recovery (Babikian et al., 2011). But there is a subset of children with mTBI who have poor outcomes and suffer longer term impairment in some areas of functioning (Thornhill et al., 2001; Babikian et al., 2011).

Most studies suggest that long term disability is most common after moderate and severe TBI, but one study concluded that levels of disability at one year post injury were similar for mTBI as for more severe TBI (Thornhill et al., 2001). Thornhill et al. (2001) looked at 549 hospital admissions in Glasgow for TBI in patients 14 years and above, and found that at one year post injury, 47% of the 362 mTBI cases had moderate to severe disability to the same degree as 45% of the 97 patients with moderate TBI and 48% of the 73 with severe TBI. It is difficult to compare subsequent research as there is inconsistency in ways of quantifying impairment and in other aspects of research methodology. But the Thornhill et al. (2001) study conflicts with others which generally find that there is a dose response relationship with severe TBI resulting in the greatest

impairment in physical and cognitive outcomes (Anderson et al., 2001; Babikian & Asarnow, 2009; Levin & Hanten, 2005).

TBI has similarities and differences to other paediatric illness (Wade et al., 2006) and therefore impacts families, friends and society in expected and unexpected ways. However its potential for long term consequences and the heterogeneity of cognitive, emotional and behavioural deficits which may continue to be identified as time and development progress are points of difference from many other paediatric illnesses (Wade et al., 2006).

The research focus on emotional problems following TBI has been gaining momentum recently (Peterson et al., 2013). Adolescents aged 12 to 17, (which is the age group of the majority of participants in this study), who sustain moderate to severe TBI are at elevated risk of increased emotional and behavioural problems particularly with internalizing symptoms such as anxiety and depression (Peterson et al., 2013). In this age group concussion can also impact on sleep quality and quantity (Sumpter, Doris, Kelly & McMillan, 2013), and lead to deficit in executive function including decision making, planning, motivation and emotional regulation (Levin & Hanten, 2005). Other problems can include elevated aggression (Dooley, Anderson, Hemphill & Ohan, 2008) and poor school performance (Prigatano, Fulton & Wethe, 2010). This age group are most likely living at home with parents or caregivers and these deficits can lead to parental anxiety, distress and family dysfunction, particularly during the first year post-injury (Rivara, 1994). Risk of emotional and behavioural problems is elevated further if one or both parents has, or develops psychiatric symptoms. There is a particularly significant risk of internalizing problems in teenagers with TBI whose mother and/or father suffer from anxiety (Peterson et al., 2013). One explanation

for this interaction is that the teenage TBI has such a stressful impact on parents and the teenager that it results in a negative impact on psychological functioning in both which leads to reciprocal impact and adjustment problems across family members (Peterson et al., 2013). Additionally, psychosocial functioning and a child's behaviour post injury has been linked to pre-injury family functioning (Anderson et al., 2001). Conversely, family functioning has also been related to the recovery of the child (Taylor et al., 1999; Peterson et al., 2013).

The parents of 37 children who had diagnoses of moderate to severe TBI described experiencing sorrow at the changes in their child and lingering sadness at the prospect of the changes being permanent (Roscigno & Swanson, 2011). Stress around meeting the needs of their child, finding out relevant information about TBI, a lack of understanding of medical TBI terminology and a lack of time for self-care was significant in the parents' lives. Another major contributor to parental stress came from others lacking understanding of the needs of a child and their family post-TBI when the child was discharged from hospital and began to resume participation in daily activities. The dominant biomedical perspective which shaped clinicians' approach to the child and was often about deficit and limitation and differed significantly from the parental, family and societal approach which was more about strengths and potential (Roscigno & Swanson, 2011).

Significant management by caregivers of the timing and extent of returning to school is also important as the increased cognitive activity involved in returning to school can exacerbate some concussion symptoms. This is an important factor in long term recovery, particularly for those with serious symptoms (Grady, 2010).

For some the stresses of a coping with a child with TBI do diminish over time. For most families with a mildly or moderately injured family member, immediate stresses at injury can fade away within a few months post injury. Some families find the way they cope with the adversity of TBI strengthens their communication and cohesion and overall family functioning (Rivara, 1994). Several factors have been identified as mitigating the burden of TBI including, severity of injury, pre-injury family functioning (Anderson et al., 2002) socioeconomic status, how the injury is responded to at its immediate onset (Rivara, 1994), child's pre-injury functioning, parents' coping style and resources available to the family including material and relational resources (Brown, Whittingham, Sofronoff & Boyn, 2013).

TBI Incidence and Outcome in New Zealand

In the 1980s, in New Zealand, the incidence of people being hospitalised for TBI was estimated to be 228 per 100,000 (Caradoc-Davies & Dixon, 1995) with a peak in males aged 15 to 24 years. From 1997 to 2004 the rate rose to 342 per 100,000 for the general population and 458 per 100,000 for people of Māori ethnicity (Barker-Collo, Wilde & Feigin, 2008). A more recent one year, regional study in the Waikato region of New Zealand went beyond hospital data for TBI and found 790 per 100,000 (Feigin et al., 2013) The Feigin et al. (2013) study identified a sample of 1369 people with TBI in the Waikato region, and revealed peaks in TBI incidence occurred in 0 to 4 year olds and 15 to 34 year old. Males were also more likely to experience TBI than females, with 69% of the sample being of male gender. Those who sustained a TBI but did not attend hospital for treatment represented 36% of the sample. There was significantly higher prevalence in individuals identifying as Māori ethnicity compared to those who

identified as other than Māori ethnicity and those living rurally were much more likely to sustain TBI than urban dwellers. Mild TBI was by far the most common of the categories of severity (mild, moderate, severe) and made up 95% of this sample. It is therefore clear from the literature that there are several factors which influence TBI incidence and these include age, gender, ethnicity and living in rural or urban areas.

TBI outcome in New Zealand appears to differ depending on ethnicity (Elder, 2012). Those of Māori ethnicity, particularly children and adolescents, face a poorer post TBI prognosis than those of non Māori ethnicity (Elder, 2012). Although they are the most likely to sustain TBI, those of Māori ethnicity are the least likely to access appropriate health care (Elder, 2012; Ellison-Lochsoman & Pearce, 2006). For those that do access health care, assessment of the consequences of TBI outcome can involve neuropsychological testing and in New Zealand this is a poor fit for those of Māori ethnicity (Dudley, Wilson & Barker-Collo, 2014). Testing methods can render their cultural identity invisible which can negatively impact test performance and subsequent diagnosis and rehabilitation (Dudley et al. 2014).

Sport and TBI

One of the main life contexts in which TBI is sustained is during sport and exercise (McCrea et al., 2013). While the risk of TBI in sport and exercise is widely acknowledged, the benefits of participation are also well known. Janssen (2006) looked at preventative benefits and positive impacts, particularly in children and adolescents, and found that physical activity can positively influence a healthy body weight, cardiovascular health, mental health, academic achievement, psychosocial health, musculoskeletal health, fitness, injuries and

asthma. The social and mental health benefits are particularly significant in relation to self-concept, anxiety, depression (Janssen, 2006), positive relationships with coaches and friends, higher self-esteem, better social skills and fewer depressive symptoms (Eime, Young, Harvey, Charity & Payne, 2013).

These benefits can be seen when comparing adolescents who took part in sport with those who did not (Eime et al., 2013). Physically active adolescents had fewer suicide attempts, greater social competence, positive school connectedness, higher confidence, better developed teamwork skills, confidence in making new friends, and better emotion control than their less active peers.

It is not only the participation in physical activity which is beneficial. It appears that who you exercise with is important. Participation in team sports, as opposed to participation in individual sport or no sport participation, has marked health benefits for children and adolescents (McKee Daneshvar, Alvarez & Stein, et al. 2014). These include: reduced anxiety, improved life satisfaction, lower social isolation, lower general risk-taking, fewer mental health and general health problems and protection against feelings of body dissatisfaction, hopelessness and suicidality (Eime et al., 2013; McKee et al., 2014). Many public health and education programs are informed by this research and aim to increase participation in sport and recreational activities. But the benefits of participation are moderated by the well documented risk of injury (CDC, 2011) including TBI.

There are various hierarchies of the riskiest sports and they change places in the list depending on the many different research contexts, focus and methodology which show different injury incidence across different sports (Thiesen, 2013). Rugby frequently features towards the top of these scales and among a group of popular high risk sports including American football, soccer

and basketball (Junge, 2004). Rugby injuries were also found to be more severe than soccer injuries (Junge, 2004). In a comparison of youth amateur soccer and rugby union, rugby players sustained 2.7 times more injuries during matches and 1.5 times more training injuries. The tackle phase of play was considered the most dangerous (Bleakley, Tully & O'Connor, 2011; Nicol, Pollock, Kirkwood, Parekh & Robson, 2010). For adolescent rugby union players the risk of injury increases with age throughout their teenage years and continues to rise into adulthood. It seems fair to speculate that this is due to an increase in power and strength which results in a faster pace of play and more forceful clashes between players (Bleakley et al. 2011). Recent research in New Zealand found that rugby was the sport during which most TBIs were sustained by those over 16 years and for those under 16 years rugby came in second behind cycling for TBI incidence. Other sports with relatively high TBI incidence for under 16 year olds were football and swimming and for over 16-year-olds, equestrian, motor biking and cycling. When the two age groups were combined the highest levels of TBI were found in rugby, cycling, equestrian and motor biking (Theadom et al. 2014).

Many other factors as well as choice of sport appear to play a part in just how at risk adolescents are. These factors can include, age, gender, previous injury, amount of participation, (Richmond, Kang & Emery, 2013) level of performance, number of practices a week, rest time and freedom to choose the intensity and duration of participation (Thiesen, 2013). Even the timing of participation has been examined in relation to injury with more injuries occurring during games than practices and more occurring during pre-season practice than mid-season and post-season practice (Hootman, Dick & Agel, 2007). Those taking part in team sports are at significantly higher risk of injury than those

participating in individual sports and if a team plays two matches a week, rather than one, the injury risk increases 6-fold (Thiesen, 2013). Obesity in adolescents also increases their risk of injury with a 34% higher risk for obese teenagers than those of a healthy weight (Richmond et al., 2013).

In the US, the most common age group for sustaining sport related TBI is 10 to 19 years and TBIs are most likely to happen while cycling or playing football (Centers for Disease Control and Prevention (CDC), 2014). Not only are younger people more likely to sustain a TBI than an adult, their injury is likely to be more severe and the recovery prolonged (CDC, 2011). The number of TBIs in sport for those aged 19 or less which require treatment at a hospital emergency department increased by 57% over an eight year period from 2001(CDC, 2015). This could have resulted from higher participation numbers, more TBIs, or better awareness of the need to report TBIs. Throughout 2009 almost 250,000 emergency department patients 19 years and under were diagnosed with TBI or concussion due to a sporting activity (CDC, 2015).

Determining the frequency of TBI in sport can be challenging as the terminology used within the sports context to refer to TBI can vary widely including, but not restricted to; 'brain injury', 'head injury', 'brain damage' (Hux, Schram & Goeken, 2006), 'concussion' (Rosenbaum & Arnett, 2010) and 'head trauma' (Pearce, Gallo & McElvenny, 2014). People hearing these terms do not assign the same understandings or definition to them (McKinlay, Bishop & McLellan, 2011). This poses problems for consistency and comparison within and between research, especially when trying to establish incidence and prevalence data (Carroll et al., 2004). This inconsistency is because the use of different terminology influences how people view different aspects of an injury, including;

the existence of an injury, the person with an injury, the characteristics of an injury and the sequalae. For example, using the term ‘concussion’ results in less people acknowledging they have experienced an injury to their brain, and less observers acknowledging an injury to the brain, than when the description ‘brain’ or ‘head injury’ is used (McKinlay et al., 2011).

How negatively or positively an injured person is viewed by others is also influenced by the way their injury is described with a ‘brain injury’ being judged more negatively than a ‘head injury’ (McKinlay et al., 2011). However, contrary to findings that understanding varies with different terminology, the way contact sport players perceive injury and anticipate the outcome after injury was not influenced by how the injury to the head was described (Edmed & Sullivan, 2015). Three groups of contact sports players did not differ in their views on an injury when it was given the diagnosis of concussion, mTBI or not given any diagnostic label (Edmed &Sullivan, 2015). Accurately determining prevalence of TBI is also hindered by the additional factor that players may not report a TBI because of return to play restrictions. These restrictions may also deter people from seeking medical attention which may result in a TBI diagnosis, particularly for mild TBIs (Theadom et al., 2014).

Recent research in New Zealand found that 21% of all TBIs were sustained during sport and recreational activities with an incidence rate of 170 per 100,000 (Theadom et al., 2014). The study used multiple data collection methods and covered a comprehensive range of sources but authors still felt prevalence figures were probably an underestimate because of variations in the description of mechanism of injury which lead to inconsistency in what data was included. Also because of TBI not being identified and recorded and injured sports participants

choosing not to seek medical attention. There was a peak in incidence in all participants in their teenage/young adult years with a higher incidence for males than females. These findings mirror those in the US where research found that males make up 71% of all sport related TBIs which require a hospital emergency department visit.

In the US, American football, is a vigorous, full contact, tackle, team sport, (Marshall & Spencer, 2001). It is played by 5.3 million children and adolescents in the US (National Sporting Goods Association, 2012) and there is a high incidence of concussion during participation (Noble, 2013). College aged American football players comprise over half of all college sport-related concussion which represents the highest rate of concussion of any college sport (Hootman, Dick & Agel, 2007). Of all high school football injuries sustained, 17% are concussion (Marar et al., 2012). As with many TBI statistics, it is argued that incidence figures are underestimates and often only include TBIs needing medical attention and therefore exclude the many TBIs for which medical treatment is not sought (Langlois et al., 2006)

As more and more is discovered about the prevalence of concussion in American football, the sequelae of concussion has also attracted much interest. Understanding the long term consequences of one or multiple concussions sustained during sport is a high priority (Lynall & Guskiewicz, 2015). It is widely accepted that for some people, concussion symptoms can persist for prolonged periods (McCrea, Perrine, Niogo & Hartl, 2013). An increased prevalence of cognitive deficit in retired National Football League players has been found (Randolph, Karantzoulis & Guskiewicz, 2013) and there is also an increased risk of neurodegenerative disease (Lehman, Hein, Baron & Gersic, 2012). Death from

a neurodegenerative disease is 3 times more likely in this retired player population than the rest of the US population. These retired players are likely to have had a football career which began in high school or college where the incidence of concussion is high (Hootman et al., 2007; Marar et al., 2012) relative to other team sports.

The awareness of the frequency and danger of concussion in sport in the US was highlighted in May 2014 when US$30million was allocated to a research project through the National Collegiate Athletic Association (NCAA) into concussion in student athletes (http://www.ncaa.org/). More than 35,000 school aged athletes are involved in the three year research project which will explore the risks, treatment and management of concussion and promote safer behaviour around reporting and managing concussion. The NCAA recognises that concussion is a serious injury in college athletes and also recognises the importance of accurate and timely diagnosis and treatment of concussion. The study will collect baseline assessment data from the participants and then compare it to post concussion data. It aims to improve concussion safety behaviour in college athletes (http://www.ncaa.org/).

TBI in New Zealand Rugby Union and League.

There has been a surge in the attention of the popular press on concussion in rugby over recent years at professional, amateur and school level in New Zealand. Several prominent, professional players have spoken to the media about their personal concussion experience such as Shontayne Hape (33) who played for the New Zealand Rugby League team, the Kiwis, and also rugby union at an international level until he retired as a result of threats to his health from repeated concussion (Deane, 2014). More recently in an interview with Radio New

Zealand News, New Zealand national and provincial rugby union player Ben Afeaki (27) announced his retirement from the game because of concerns over his long term health and recurrent post concussive symptoms (http://radionz.co.nz).

It might be argued that one contributing factor could be that return to play (RTP) guidelines were not always adhered to by injured elite and club level New Zealand rugby union players and also that full recovery was not always reached before return to play (Beardmore, Handcock & Rehrer, 2005)

Severe head injury at the school rugby level, such as 17-year-old Jordan Kemp who died following a severe head injury sustained while playing rugby union in July 2014 in New Zealand (Associated Press, 2014), has added to the interest and concern around concussion. Of the total number of new ACC claims for sport related head injury during the 12 month period from July 2013 (5,583), 1,958 were sustained during rugby league and rugby union and cost ACC $2,122,121.00 (www.acc.co.nz).

Research has reinforced the concerns of the popular press and public in New Zealand by confirming a high incidence rate of concussion in rugby. In a study of sport-related head injury during a 10 year period from 2001, King et al. (2013) found that rugby union was responsible for more ACC claims for moderate to severe concussion than any other sport (www.acc.co.nz).

There are responses to concerns about concussion in rugby at the international, national and local level. The International Rugby Board (IRB) has introduced a mandatory three week stand down period for child and adolescent players who experience concussion. The rule forms part of the comprehensive IRB Concussion Guidelines which are one of the many resources about

concussion on the IRB website (http://www.irbplayerwelfare.com/) although the effectiveness of this intervention is yet to be explored.

Several education and prevention strategies have been implemented by organisations governing the sport. The New Zealand Rugby Union (NZRU) website outlines several measures addressing concussion including the Sideline Concussion Checklist, the Returning to Play Following Concussion flyer, and the Smallblacks Development Programme (http://www.nzru.co.nz). The New Zealand Rugby League (NZRL) website has a comprehensive 11 page document titled Concussion/Head Injury Policy, which contains a Sideline Concussion Checklist, Concussion Management guidelines, and tools and information about several other aspects of concussion including post concussive symptoms and post-concussion syndrome (http://www.nzrl.co.nz).

Tools to help assess and identify concussion in rugby have emerged including the King-Devick (KD) test (Galetta et al., 2011) and the Sports Concussion Assessment Tool (SCAT3) (King, Brughelli, Hume & Gissane, 2013). The KD proved reliable in identifying a concussion in New Zealand rugby union players who had self-reported a potential concussion but also in those who had experienced a blow to the head but did-not self-report concussion symptoms. The KD has been found to be a useful and accurate sideline concussion assessment tool which can be administered very quickly and then followed by the use of the lengthier SCAT3 (King, Gissane, Hume & Flaws. 2015).

ACC and NZRU (http://www.nzru.co.nz) launched a joint initiative in 2001 to reduce injury numbers and make rugby union a safer sport (Gianotti, Quarrie & Hume, 2009). The RugbySmart educational programme targets coaches and referees through resources and workshops. An evaluation of its effectiveness,

ACC injury claims were found to have reduced in the areas which were the focus of the RugbySmart material. Players also reported safer behaviours in some areas while playing rugby (Gianotti, Quarrie & Hume, 2009)(www.acc.co.nz).

These types of educational strategies to maximise injury prevention are important given the mounting acceptance of the evidence that headgear does not prevent concussion (McIntosh, et al., 2009). Some researchers are so convinced that headgear is not a concussion prevention tool that they do not support the recommendation or mandate of its use by rugby players (McIntosh et al., 2009).

TBI in Rugby Union and League in New Zealand Secondary Schools.

Sport is a big part of school life in New Zealand and participation rates are recorded by the New Zealand Secondary School Sports Council (NZSSC). According to the NZSSSC, secondary schools across New Zealand offered 84 different sports during 2013 which were engaged in 125,783 times by girls and 145,204 by boys. Rugby Union and League were included in this list and attracted involvement by boys and girls 32,222 times throughout 2013. Rugby Union was the second most played sport in secondary schools in 2013 behind outdoor netball (NZSSSC, 2014). But playing comes with risk and the risk of injury, including concussion, which in rugby union is high (Junge, Cheung, Dvorak, 2004).

ACC statistics showed that new claims for head injury in 10 to 19-year-old rugby union and league players has increased annually since 2009 with 1273 new claims during a 12 month period from July 2013 (ACC, 2014) However, these figures may not be a true reflection of all rugby head injuries as many players may not seek medical attention, may be unaware they have a head injury, or may overlook a head injury as other injuries take precedence for treatment (Theadom et al., 2014) and therefore not make an ACC claim (www.acc.co.nz). The rugby

community is responding at an international, national and local level to concerns around concussion in school rugby. The NZRU and NZRL websites offer a wide range of information on concussion and all resources and guidelines are strongly recommended for use at the secondary school level of play (http://www.nzru.co.nz; http://www.nzrl.co.nz). The aforementioned RugbySmart educational programme also extends to coaches and referees at the secondary school level (Gianotti, et al., 2009).

The IRB RTP guidelines which apply to schoolboy rugby in New Zealand (Sye, Sullivan and McCrory, 2006) rely on a suspected concussion being reported, and an assessment to confirm concussion (King et al. 2014). However these assessments are not always carried out as many players do not report their injury. McCrea, Hammeke, Olsen, Leo and Guskiewicz (2004) found that of those in a sample of amateur sports people who had sustained a concussion only 47% reported their injury. If injuries are not reported, IRB RTP guidelines cannot be applied.

Research findings which could further support the focus of prevention strategies have identified the beginning of the season as the time when players are at the highest risk of injury. Adolescent rugby union players' injury frequency peaked during the early season and declined as the season progressed (Bleakley et al, 2011). This early season injury peak has also been reported in New Zealand Premier grade rugby union players (Schneiders, Takemura & Wassinger, 2009).

It is therefore important that rugby players and those around them know the symptoms of concussion and the importance of seeking help.

Public Knowledge and Attitude to TBI

Knowledge of and attitude towards concussion and its symptoms has been previously researched in lay people in New Zealand and abroad. In 1988, Gouvier, Prestholdt and Warner, surveyed 221 members of the American public aged over 15 years in a Louisiana shopping centre. One quarter of all responding endorsed myths about brain damage including 27% of respondents thinking a person had to be knocked out to cause brain damage, 47% thinking whiplash couldn't cause brain damage, 31% believing most people with brain damage look and act retarded and 26% being unaware that emotional problems following brain injury were related to the injury. When asked about unconsciousness following brain injury, almost 45% of respondents endorsed myths. Almost 60% of respondents incorrectly thought a person woke up shortly after unconsciousness and had no lasting effects, 41% believed that after waking from a prolonged coma an injured person could recognise and speak to others immediately and 31% thought that a comatose person was aware of what was going on around them. Gouvier et al. (1988) commented that accurate information and knowledge could be an important component of better recovery and adjustment.

Gouvier et al. (1988) also found a lack of understanding around amnesia with 82% incorrectly believing that a person with amnesia from a brain injury would be normal in every other way and around half of respondents being unaware that amnesia can lead to trouble learning new information and problems remembering events after the injury. A similar number incorrectly thought that a second blow to the head could help a person remember things they had forgotten.

This belief in myths about brain injury continued through responding about recovery as 74% of respondents did not know that a person who had one

head injury was more likely to experience another. The effort a person puts in to rehabilitation was thought to be the main determinant of level of recovery by 70% of respondents and 61% thought rest and inactivity was good advice following a head injury.

Personal experience of a head injury did not appear to affect knowledge, nor did contact with health care professionals other than to improve knowledge about rehabilitation practices and risk of re-injury. Gouvier et al. (1988) concluded there was a need for increased education of the general public about the impact and severity of head injury.

Five years later Willer, Johnson, Rempel and Linn, (1993), surveyed similar general populations in shopping centres in Western New York State, America, and Southern Ontario Canada, using several of the same items as in the Gouvier et al. study (1988). They concluded that results showed a lack of knowledge consistent with the findings of Gouvier et al. (1988) and suggested that inaccuracies in younger people are taken with them into future careers, some in health care, to the detriment of efforts to establish effective rehabilitation strategies. The authors noted that a large proportion of respondents thought that a second head knock would restore memory. Willer et al. (1993) agreed with Gouvier et al. (1988) in calling for better public education on brain injury and its consequences.

A follow-up study was conducted (Guilmette & Paglia, 2004) which used similar measures to survey members of the public who were customers at a major motor vehicle department in New England, America. Researchers found a lack of knowledge around moderate and severe TBI similar to that of the previous two studies but found that respondents had better knowledge around the potentially

damaging impact of mTBI. Authors again noted that 42% of respondents thought a second head knock would restore memory function and made a similar call for increased public education of TBI.

A further replication study was completed in 2006 by Hux et al, in America (state not specified) aimed at updating information on public knowledge of brain injury and specifically to see if knowledge had changed over time since the Gouvier et al., study in 1988. Hux et al., (2006) categorised findings by dividing items into four specific areas; General TBI knowledge, Coma, Memory deficit, and Recovery. Findings showed that the general public still had inaccuracies of knowledge around TBI. One item which showed a consistent lack of knowledge in the studies by Gouvier et al., (1988) Willer et al., (1993) and Guilmette (2004) was that those who sustain a brain injury can have impaired memory to the extent of not recalling their past life or recognise familiar people but be normal in every other way. Hux et al. (2006) found that the number of respondents incorrectly believing this to be true had increased. Notable increases in inaccurate responding were also found for the notion that people in a coma are aware of what is going on around them and complete recovery from severe head injury is possible. Overall Hux et al. (2006) concluded that the extent to which the general public held misconceptions around general knowledge of head injury had decreased substantially since research by Gouvier et al. (1988) but had remained consistent in the domains of coma and unconsciousness, memory and recovery. The authors expressed concern that many people thought the level of recovery was dependent on the effort and hard work of the injured person while in fact recovery level is more often outside the control of the individual, particularly for severe TBI. Males and people with personal experience of brain injury had better

knowledge about the topic and there was generally good knowledge around the impact of second or multiple head injuries. Further education was described as 'paramount' (p553) to enlighten people about the widespread occurrence and serious consequences of head injury. Chapman and Hudson (2010) replicated the Hux et al. (2006) study in a sample of the general public in Britain and expressed similar concerns over findings. The study showed that overall in the sample of 322 adults, there were misunderstandings of unconsciousness, an underestimate of common memory problems following brain injury and misinformation around the recovery process and risk of subsequent brain injury.

In New Zealand, McKinlay, Bishop and McLellan (2011) found that the majority of a sample of 103 members of the general public who had experienced a concussion, incorrectly thought someone with a concussion should be kept awake. The majority of respondents were correct in their knowledge that it was not safe to return to play as soon as confusion cleared, effects of concussion could be long term and symptoms can sometimes not show-up for several hours. Overall McKinlay et al. (2011) concluded that there was still "significant uncertainty" (p.765) in the general public's knowledge of what a concussion is and how it should be managed and this was a concern which needed addressing through further research and education.

The various findings of these studies will be examined in relation to the current study in the discussion section. Table 17 shows responding to comparable items used in previous studies.

Sport Related Knowledge and Attitude to TBI

The interest in TBI in rugby has gained momentum recently and has led to the implementation of various awareness and educational strategies, many of

which are aimed at high school rugby players. The effectiveness of various strategies to prevent risky practices and educate about concussion in rugby is unclear. But it is evident that more information which will help to streamline and target intervention strategies is an important way of attempting to increase their effectiveness. Research in New Zealand and abroad has assessed the knowledge and attitude of sport-related populations around concussion.

King, Brughelli, Hume and Gissane (2014) described concussion in sport as a 'mystifying subject.' They looked at 286 peer reviewed publications about sport-related concussion and aimed to "review and update the literature in regard to the history, pathophysiology, recognition, assessment, management and knowledge of concussion" (p. 449). The review found that the majority of research on concussion knowledge had looked at the knowledge of sport management teams, coaches and parents rather than player knowledge. Authors found that all past and present guidelines have stipulated that the sports person must be free of post concussive symptoms while at rest and while exercising before returning to play.

In a New Zealand sample of secondary school rugby union players with an average age of 17.5 years, Sye et al. (2006) found that of 296 who thought they had experienced concussion, 59 had failed to report their suspected injury. This shows a much higher reporting rate (62%) than that found by King et al. (2014) for contact sport in general. However the Sye et al. (2006) study was based on a New Zealand sample while the King et al. (2014) research was a review of literature from several countries. Over half of the concussed players (154) made their own decision about returning to play rather than adhering to medical advice. A 'reasonable knowledge' (p.1003) of concussion symptoms was reported but

many players believed “being knocked out cold” was the most conclusive indicator of concussion. A quarter of the sample thought a concussed player should play in an important match such as a final (Sye et al., 2006). The Sye et al. (2006) study involved 477 male, high school rugby playing participants recruited nationally across New Zealand. The participants were asked about “their rugby background; their knowledge and understanding of concussion and return to play guidelines; the source of their information; its applicability to their playing situations and whether they thought the guidelines were being followed” (p.1003). The finding that many players thought a concussion could only result from being knocked out could lead to potential under reporting of concussion. However researchers were encouraged by the relatively high number of players self-reporting a concussion. Although a relatively small number (22%) sought medical clearance before returning to training and match play and less than half of players were aware of return to play guidelines and around half made the decision to return to play themselves. The study only included 1st XV players who are the senior secondary school rugby union players. It focused on knowledge and understanding of concussion return to play guidelines and did not ask about a broader understanding of concussion or about player attitudes to concussion.

In America, Chrisman, Quitiquit and Rivara (2014), found that coaches of soccer and football teams received more extensive education on concussion than players and players’ parents which meant coaches had relatively good concussion knowledge compared to players and parents. However, education of coaches does not always translate to better knowledge in players (Rivara et al 2014). Also in America, Gourley, Valovich McLeod and Curtis Bay (2010), found no significant difference in concussion symptom knowledge of school aged athletes and their

parents and found that there was better knowledge around common symptoms than the less common. A sample of 81 school aged American football players also had better knowledge of common concussion symptoms than less common but authors were alarmed that not all players were aware of the two most common symptoms; headache and dizziness, and therefore might return to play unaware of a concussion (McAllister-Deitrick, Covassin & Gould, 2014). Parents who had a first aid certificate or general medical training and had better knowledge of concussion symptoms but poor knowledge of proper concussion management and a need for more education around seeking medical help and return to play decisions was found in athletes and parents (Gourley et al. (2010). In contrast with the Sye et al. 2006 study, a large majority of respondents (77%) knew that a sports person did not have to be knocked out to sustain concussion (Gourley et al., 2010). A number of athletes and parents thought a player could return to sport while still experiencing concussion symptoms and most were unable to correctly recall return to play guidelines. Authors (McAllister – Deitrick et al., 2014; Gourley et al., 2010) voiced concerns about this lack of knowledge and its potential for concussed athletes returning to play while vulnerable to subsequent concussion.

Even the implementation of laws to help prevent risky return to play practices did not ensure safe practice in a group of American high school soccer and football players, of whom 69% returned to play while suffering concussion symptoms (Rivara et al., 2014).

The Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST), has previously been used in a previous study involving American football players from two Californian High schools (Manasse-Cohick &

Shapley, 2014). The RoCKAS-ST was used as a pre and post measure to assess the impact of an educational programme on TBI knowledge and attitudes (Manasse-Cohick & Shapley, 2014) and found there was a significant increase in TBI knowledge following the education programme but not in the safety of attitudes. Researchers commented that players already had relatively safe average attitude scores at the start of the study which may account for the lack of significant increase in safety of attitudes following education.

In comparison in England, the same measure (RoCKAS-ST) was used in a small group of soccer players to assess concussion knowledge and attitude (Williams, 2013). The participants comprised twenty-six adult soccer players in the English championship league including players from England, Ireland, America, Norway, Scotland, New Zealand and Wales. Results indicated they had good knowledge around symptom duration, effects on performance and loss of consciousness.

Purpose and Aims

It is therefore apparent that TBI is prevalent internationally at significant financial and human cost to those injured and those around them. Sport is an arena in which risk of TBI is high and incidence is widespread. Contact sports such as rugby, pose a particular risk and rugby is played extensively during the school years in New Zealand. TBI in rugby is ubiquitous and there is a growing awareness of the pervasiveness and seriousness of TBI in school aged New Zealand players. It is important to know what these players think about concussion so that prevention strategies can be developed appropriately. However research to evaluate what school aged rugby players think about concussion is scarce. Following their comprehensive review of literature on sport related

concussion King et al. (2014) advocated for return to play (RTP) guidelines to be individualised to the player and for sport participants' knowledge of concussion to be rigorously evaluated. They also found that the majority of literature looked at knowledge of sport management teams, coaches and parents rather than player knowledge.

One aim of this thesis is to add to information from previous studies by again looking at knowledge and attitude around concussion in secondary school rugby players. To maximise the gains of any concussion prevention strategies in this age group and to identify any potential obstacles to their delivery it is important to understand players' current knowledge of concussion and their current attitude towards concussion. An awareness of attitudes is important as they have an impact on risk taking actions in this age group (Finch, Donohue & Garnham, 2002). However, improving concussion knowledge, awareness and attitude is not a straightforward task (Lynall & Guskiewi, 2015). Education of players, parents and coaches is seen as a key strategy which would be enhanced by well-informed refinement of educational interventions (Lynall & Guskiewi, 2015).

Therefore the current study aims to explore school age rugby players' attitudes and knowledge around concussion including symptoms, outcomes, recovery and returning to play, in the hope that findings will be useful to inform and target future strategies to educate school aged rugby players about concussion prevention, management, appropriate recovery and safe return to play.

Chapter Two: Method

Procedure

The research was granted ethics approval by the School of Psychology Ethics Committee at the University of Waikato. Participants were informed that their completion and submission of the survey online or on paper was interpreted as their consent to take part in the research.

Participants were mainly recruited through New Zealand secondary schools. Male and female students enrolled in year nine or above, aged 11 to 19 years who were rugby union and/or league players during 2014 were invited to participate. Engagement in rugby union or rugby league at any level meant students were eligible participants. New Zealand secondary schools were identified from the New Zealand Ministry of Education school directory, current at April 1st, 2014. One school was removed from the list as two students who were eligible for the study were related to the researcher and others were known to the researcher. A list of 343 secondary schools, 163 composite schools and three restricted composite schools met the criteria of having students in year nine and/or above, 509 schools in total. An initial screening email was sent asking schools if they had rugby union or league teams. Figure 1 shows the contact process with schools. Within the 509 total schools contacted, 41 schools identified as Kura Kaupapa Māori schools in the New Zealand Ministry of Education (2014) school directory, current at May 15th, 2014. Of these, 26 indicated they did not have rugby league or union teams or did not want to distribute details of the research. The remaining 15 Kura Kaupapa Māori schools were offered a Māori language translation of the survey (see Appendix B) to distribute to their players. Letters of introduction including information about the research were sent to school

Principles and Board of Trustees. For the schools which responded positively to the introduction letter, further correspondence was sent including a link to the online survey and an email address to request a paper copy of the survey. The schools were asked to distribute the survey details to potential participants in several ways including by email, newsletter, via team coaches, posters on notice boards, messages in verbal notices and via social media. Players who were interested in taking part could either access an online survey version which was developed using the online survey software Qualtrics Survey Solutions (2014)(see Appendix A) or email and request a paper copy be emailed or posted to them. If paper copies were requested, they were printed and posted by the author including a pre-paid, pre-addressed envelope for return to the author. In some cases schools printed copies out themselves.

The New Zealand Rugby Union, New Zealand Rugby Players Association, New Zealand Rugby League, New Zealand Secondary Schools Rugby League, New Zealand Secondary Schools Sports Council, and the Thames Valley Representative Rugby programme were also asked to distribute an invitation for eligible players to take part in the survey via the online link or paper copies of the survey. Responses could not be linked to any specific schools, organisations or individuals.

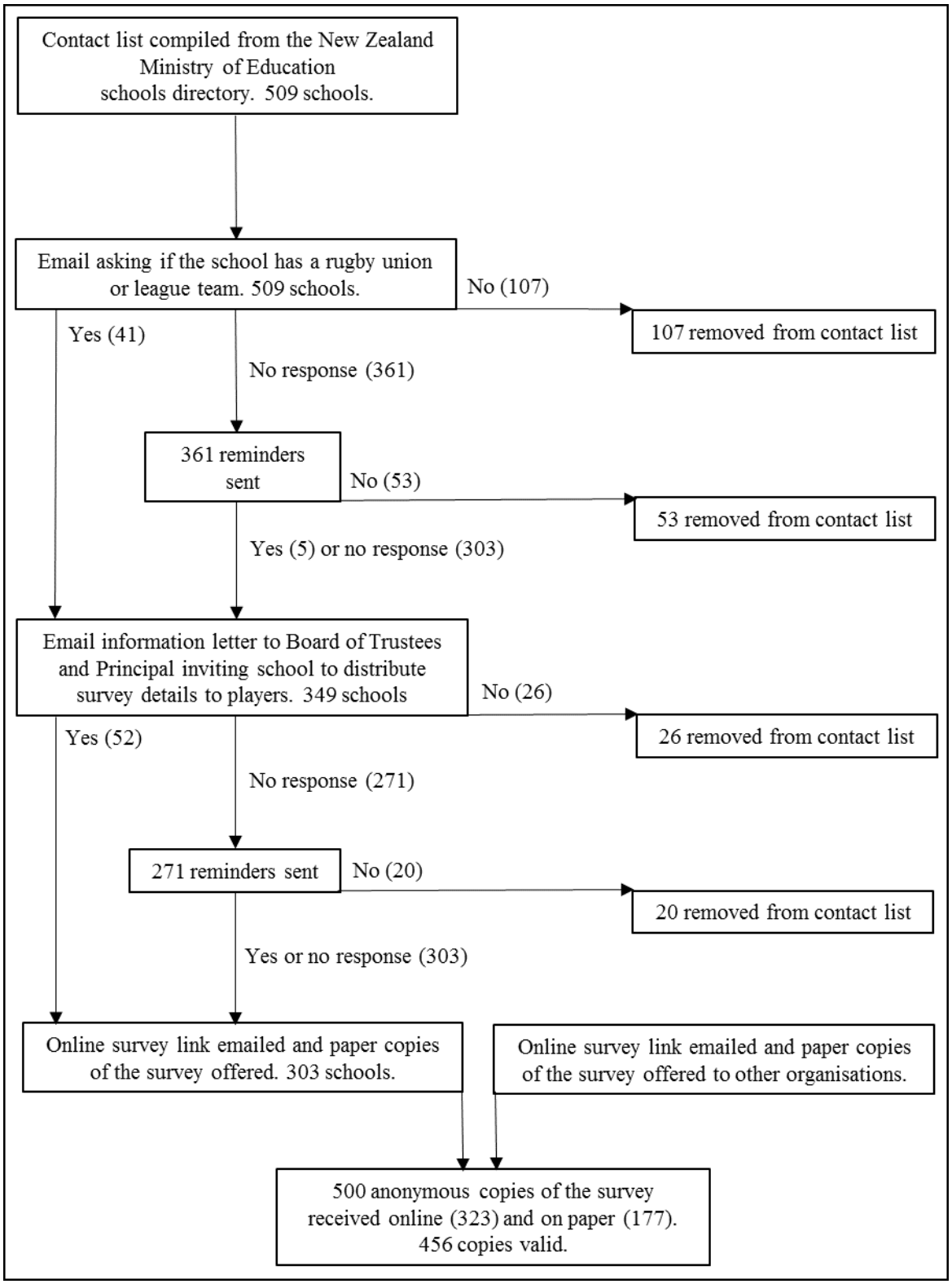

Figure 1. Distribution of the survey via New Zealand secondary schools.

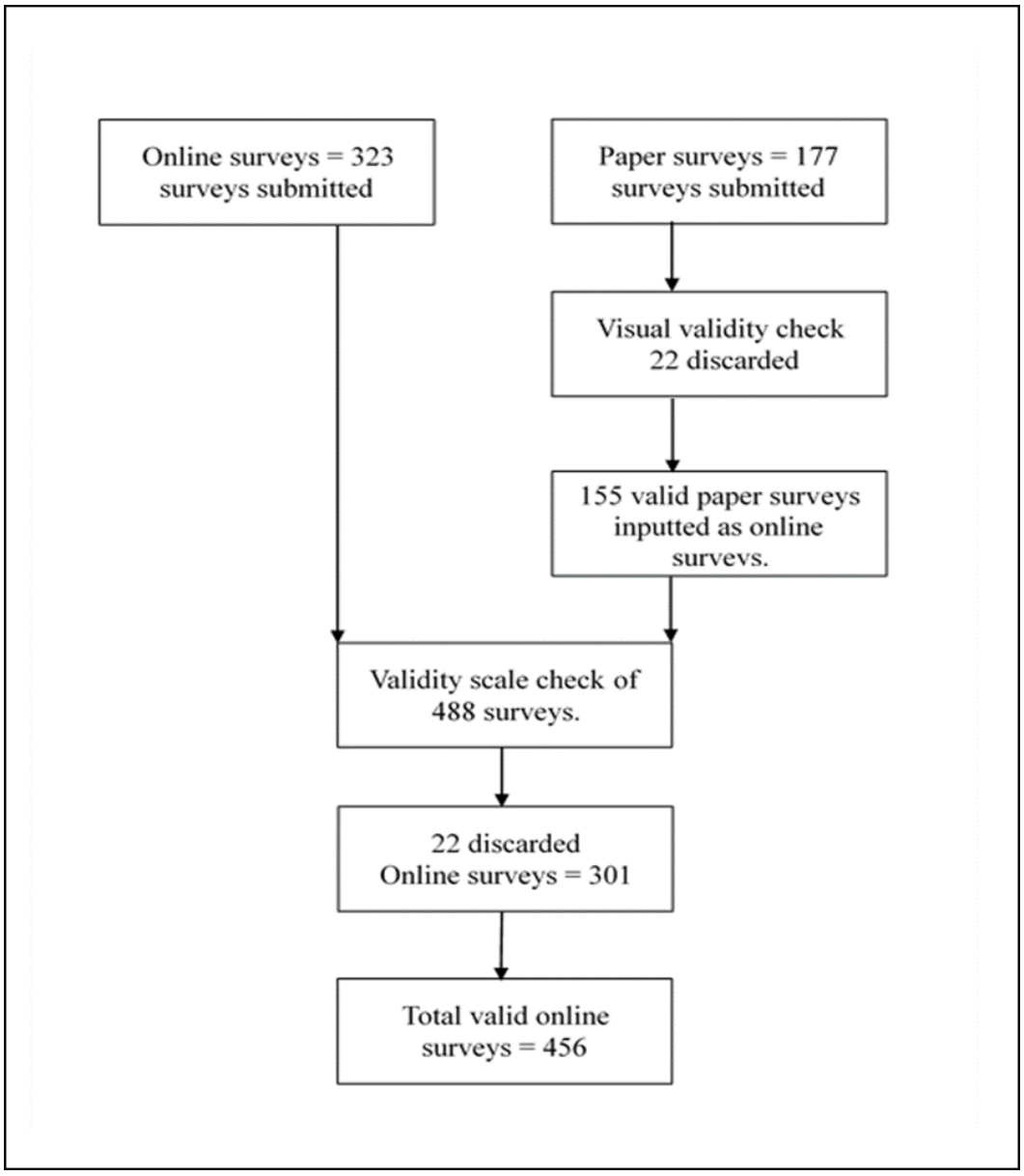

Figure 2. Method of survey submission and validity check.

The distribution and collection of surveys covered a five month period from half way through the school year (early July 2014) and concluded at approximately the same time as the end of the school year (early December 2014). The time frame between initial contact and follow up varied as responses came in at varying times and were responded to as they arrived throughout the distribution period.

All copies of the survey which were submitted on paper (177) were entered in to the online survey software by the author. During this process 22 surveys were discarded as a result of visual screening for the following reasons; seventeen were invalid as the participants appeared not to engage with the survey and had ticked or circled answers down the left or right hand side of the column for all of the items, three were invalid as only the demographic page of the survey was partially completed and no attempt was made to answer the survey items, one was discarded as only five items were answered and the choice of answer was illegible, and one was discarded as only three items were answered. A further 22 surveys were discarded as they failed to meet the validity scale criteria (as described in 'Measures'). Therefore, of the 500 completed surveys collected online or on paper, 44 were invalid and discarded, which left a final sample of 456 valid surveys. The submission of surveys and validity checks are shown in Figure 2. A brief, condensed summary of findings was written and distributed to all participants who had requested feedback and all other parties who were considered to have an interest in the research.

Demographics and Other Relevant Factors

Participants were asked their age, gender, ethnicity, the number of years playing rugby, whether they played rugby union, or rugby league or both, how long they had been playing, whether or not they had experienced concussion, how many times they had experienced concussion, and whether or not they felt they knew enough about concussion.

Measures

To assess what participants knew about concussion and their attitude towards concussion the Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) was used. This survey was developed specifically for high school athletes in America to measure how they felt about concussion and what they know about concussion in. The measure was developed as Rosenbaum & Arnett (2010) reported that other surveys (Livingston & Ingersoll, 2004; Sye et al., 2006) which looked at concussion attitude and knowledge lacked psychometric data and others (Sefton, 2003; Simons, 2004) did not fully address the wide range of features related to concussion such as attitude, knowledge and supervision. The RoCKAS-ST comprised 55 items including general statements and statements relating to rugby related scenarios (see Appendix C). Of these 55 items, 48 examined the two domains of knowledge of and attitude towards concussion. Seventeen of these included statements with an optional True or False answer and fifteen had a five-point Likert response choice including; Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. Sixteen items were presented in a table of eight actual post-concussive symptoms and eight non post-concussive symptoms (distractor symptoms) and participants were asked to identify the legitimate and non-legitimate symptoms (see Appendix A). Of these 48 items 25 were used to examine to concussion knowledge and 15 to examine attitudes towards concussion. The items relating to knowledge of concussion comprised the RoCKAS-ST Concussion Knowledge Index (CKI). The items which related to attitude towards concussion comprised the RoCKAS Concussion Attitude Index (CAI).

For the CKI, correct answers scored one point per item and incorrect answers scored zero. The CKI could result in scores ranging from 0-25. The items comprising the CAI included a range of two safe, one neutral and two unsafe response options. These items were scored from one to five depending on the level of safety of participant's choice of answer. Total scores for the CAI could range from 15 to75. Higher scores for the CKI indicated greater knowledge of concussion and higher CAI scores indicated safer attitudes around concussion (Rosenbaum & Arnett, 2010). There were five items which were not included on the knowledge or attitude index and they were coded as no index (NI). Index loading and the scoring and answer key for all RoCKAS-ST items can be seen in Appendix C.

The survey also included a validity scale (VS) made up of three items, each with a True of False answer option. These items were designed to identify participants who were not engaging with the survey or showing inconsistent engagement. Correct responses were given one point and incorrect response scored zero. The total score range on the VS could be zero to three. The VS was used to test the validity of completed surveys and those with a VS score of zero or one were deemed invalid and therefore discarded. Appendix A includes details of which items loaded on which index.

Seven items within the CAI referred directly to personal opinions on returning to play after concussion. These items were grouped together to form an index called the RoCKAS- ST Return to Play Index (RTP). The possible scores on this index ranged from 7 to 35 with higher scores indicating safer attitudes. This allowed for a more specific evaluation of attitudes to returning to play after concussion through analysis of the RTP scores.

During its development the RoCKAS-ST was examined by a group including high school students, psychologists and neuropsychologists who were asked to review the survey and identify any potentially confusing, irrelevant or problematic content (Rosenbaum & Arnett, 2010). Some minor word changes and the removal of one item followed this consultation which aimed to improve face validity and content validity. Socially desirable responding was not deemed to be a strong influence on the reporting of attitudes to concussion. Test re-test liability of the attitude domain of the survey was reported as adequate following a significant positive correlation of scores taken at the first and second time participants filled in the survey (Intraclass correlation coefficient (ICC) = .79, $p <$ 001). The knowledge domain test-retest reliability was slightly less stable (ICC = .67, $p < .001$).

Therefore, this rigorous psychometric review indicated the RoCKAS-ST was a stable measure of concussion attitudes and an acceptable measure of concussion knowledge which is comprehensive in covering knowledge of the etiology, progression and outcomes of concussion and evaluating attitudes towards reporting and management of concussion (Rosenbaum & Arnett, 2010).

As well as the RoCKAS-ST, a further measure was used to evaluate knowledge of concussion. This measure examined participants' understanding and misconceptions about concussion and was called the Misconception Index (MI) (Hux et al., 2006). The MI was originally designed by Gouvier et al., (1988) as a 25 item survey and was used to examine the general public's knowledge of brain injury and the recovery process in research in Southern Louisiana, USA. The original version was shortened to 17 items by Hux et al. in 2006 and included in a study with participants from regional shopping malls in an unspecified state of

USA. The 17 item MI included four about general knowledge of brain injury, three about coma and unconsciousness, four about memory deficit and six about recovery. The available optional answers were; True, Mostly True, Mostly False, False (see Appendix E). For the purposes of scoring, analysis and reporting, the True and Mostly True responses were grouped as True, and the False and Mostly False responses were grouped as False (Gouvier et al., 1988). The percentage of choice of answer was used to indicate how accurate or inaccurate participants were in their knowledge of the effects brain injury and recovery from brain injury (Hux et al. 2006).

Terminology

While it would have been preferable in the current research to consistently use one term with an internationally recognised definition of a TBI, it is unlikely that the secondary school participants would be aware of the complexity of different terminology use and any perceived bias. Also rugby in New Zealand is dominated by the term 'concussion.' The NZRU talks of 'concussion' throughout its website. The term is also used throughout a 'sideline concussion checklist,' a flyer titled 'Return to Play Following Concussion,' and the RugbySmart injury prevention program. The NZRL also uses the term 'concussion' frequently but also refers to 'concussion/head injury,' and 'head injury.' Documents are called 'The NZRL Concussion Policy Summary,' 'The NZRL Concussion and Head Injury Policy,' and 'The NZRL Concussion and Serious Injury Report Form.' A further terminology is used in the title of the NZRL document 'The NZRL return to play guidelines, developed in conjunction with The Brain Injury Association of New Zealand' (http://www.nzru.co.nz; http://www.nzrl.co.nz). Following Ehmed and Sullivan's (2015) recent findings that contact sport players' perception of

injury and anticipation of outcome was not influenced by how the injury to the head was described, and also to maximise consistency so there could be a comparison to previous research, the terms used in the original versions of surveys were retained throughout this research. Therefore in the current research, the RoCKAS-ST part of the survey, retained the terminology of the original survey (Rosenbaum & Arnett, 2010) which was 'concussion,' whereas the MI part of the survey used the terms 'brain injury' and 'brain damage,' which was consistent with the wording of the original items (Gouvier et al., 1988) and those used in replication research (Willer et al., 1993; Hux et al., 2006). Other information in this thesis included the terms TBI, brain injury and head injury interchangeably and depending on the terminology used in research being referred to.

Piloting the Survey

As the chosen measures for this study had been developed overseas, they were piloted to determine their relevance to the New Zealand population. Of seven pilot participants who met the criteria to take part in the study, five were males and two females, one was of Fijian ethnicity, one of Indian ethnicity, two of Māori ethnicity and three of Pakeha ethnicity. Three of these participants completed the online version of the study and four completed the paper version. They were asked to point out anything which was confusing, unclear or they did not understand. A medical doctor currently practicing in New Zealand was consulted about changes to medical terms which were not understood by the pilot study participants. A cultural supervisor of Māori ethnicity also evaluated the survey for cultural appropriateness.

Following the pilot study it was identified that several items in the RoCKAS-ST required rewording to better reflect language commonly used in New Zealand and to aid understanding by the participants. These changes are shown in Table 1. Other changes were made so the wording of the survey was relevant to both male and female participants and was relevant to the sport of rugby. Terminology which related to males only was changed to male and female e.g. his became his/hers. When words related to athletes or sport in general they were changed to relate to rugby players and the sport of rugby e.g. athlete became player and sport became rugby. The term 'athletic trainer' which appears in some items was discussed as it is more common in America than New Zealand. The pilot participants understood the term to mean an adult with some specific knowledge of sport related health and wellbeing over and above that of a secondary school player. This appeared to be an acceptable understanding of the term for its purpose in this study.

Table 1: Item Changes Following the Pilot Study

Measure	Item	Original wording	2014 wording
RoCKAS-ST No index	Section 1, item 2.	Running everyday does little to improve cardiovascular health.	Running everyday does little to improve heart health.
RoCKAS-ST Validity Scale	Section 1, item 4.	Cleats help athletes' feet grip the playing surface.	Sprigs help players' feet grip the playing surface.
RoCKAS-ST Validity Scale	Section 1, item 15.	High-school freshmen and college freshmen tend to be the same age	The colour of your rugby short has an effect on whether you get concussion or not.
RoCKAS-ST CKI	Section 5, item 1.	Hives	Allergic rash
RoCKAS-ST CKI	Section 5, Directions.	Check off	Tick off

MI	Section 6, item 15.	People with amnesia for events before the injury, usually have trouble learning new things.	People with amnesia/memory loss for events before the injury, usually have trouble learning new things.

Sample Characteristics

Sample characteristics of the participants are shown in Table 2. Any ethnicity which represented less than 3.1% of the sample was included in the 'other' category. This comprised nineteen ethnicities which were American, Australian, Cook Island, Dutch, English, European, Fijian, Irish, Italian, Kiributiun, Korean, Native American, New Zealander, Niuean, New Zealand European, Pacific Islander, Samoan, Tokelaun and Tongan. As recorded by the 2013 Statistics New Zealand census, the population is made up of 14.9 % of people of Māori ethnicity, 74 % of European/Pakeha ethnicity and approximately 11% of other ethnicity (http://stats.govt.nz). In this sample participants of Māori ethnicity were over represented at 22.1% compared with the ratio of the general population.

The mean age of participants was 15.37 (*SD* =1.61). As expected (given the focus on rugby players) the sample included more males than females and this ratio closely resembled the New Zealand Secondary School Sport Census Data (2013) which showed the percentage of gender playing rugby union and rugby league as 10.3% female and 89.7% male.

Table 2: Sample characteristics n(%) (N=456)

Demographics and Variables	Total Sample n(%)	Male n(%)	Female n(%)
Gender		409(89.7)	47(10.3)
Age			
11	1(0.2)	1(0.2)	0
12	5(1.1)	5(1.2)	0
13	56(12.3)	51(12.2)	5(10.7)
14	92(20.2)	86(20.6)	6(12.8)
15	95(20.8)	85(20.4)	10(21.3)
16	72(15.8)	61(14.6)	11(23.4)
17	90(19.7)	79(19.0)	11(23.4)
18	41(9.0)	37(8.9)	4(8.5)
19	4(0.9)	4(1.0)	0
Culture most identify with?			
Māori	101(22.1)	88(21.1)	13(27.7)
Pakeha	285(62.4)	263(63.1)	22(46.7)
Other	70(15.3)	58(13.9)	12(25.6)
How many years playing secondary school rugby?			
1	124(27.1)	102(24.5)	22(46.7)
2	102(22.3)	92(22.1)	10(21.3)
3	78(17.1)	70(16.8)	8(17.0)
4	57(12.5)	53(12.7)	4(8.5)
5	50(10.9)	49(11.8)	1(2.1)
6	45(9.8)	43(10.3)	2(4.3)
Code participant playing?			
Rugby union	402(88)	367(88.1)	35(74.6)
Rugby league	18(3.9)	12(2.9)	6(12.8)
Both union & league	36(7.9)	30(7.2)	6(12.8)
Has participant ever had concussion?			
Yes	224(49)	205(49.2)	19(40.5)
No	232(50.8)	204(49.0)	28(59.6)
If ‘Yes,” how many concussions sustained?			
1	138(30.2)	127(30.5)	11(23.4)
2	50(10.9)	43(10.3)	7(14.9)
3	18(3.9)	18(4.3)	0
More than 3	15(3.3)	14(3.4)	1(2.1)
Does participant feel they know enough about concussion?			
Yes	199(43.5)	185(44.4)	14(29.8)
No	257(56.2)	224(53.8)	33(70.3)

Data Cleaning and Statistical Analysis

Data was collected and downloaded from the Qualtrics Survey Solutions (2014) website and statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) Version 21 (SPSS, Inc., 2012).

Within the 456 valid surveys there were noticeable areas of missing data. Some blocks of missing data comprised whole sections or represented more than 20% of CKI, CAI and other indices. Methods of replacing missing responses were considered. Complete case analysis or listwise deletion was thought to be a waste of other useful data (Rassler & Riphahn, 2006) as participants may have omitted responses in some sections but responded fully in other sections. Mean imputation of group, variable or individual data was also looked at but although mean imputation would have increased the sample size by adding cases which could be included in analysis it would not have added any new information (Howell, 2008).

Scores on the CKI, CAI, MI and RTP were reached from totalling the scores of individual items on the index. Therefore as replacement methods had been rejected, casewise deletion (Howell, 2008) was used. This meant that if a response to any item in a section which contributed to an index was missed, the whole section was deleted for any analysis involving that index. Any participants who missed responding to any item on an index were not included in the analysis involving that index. Casewise deletion has the benefit of leaving parameter estimates unbiased but the disadvantage of a potential loss of statistical power (Howell, 2008). Casewise deletion was applied to the CAI, CKI, MI and RTP. This deletion meant the value of *n* differed across analysis therefore all *n* values are shown in the results tables.

Prior to analysis, the data was explored to examine whether relevant test assumptions were met, such as population normality and homogeneity of variance. Statistical tests included Levene's Test of Equality of Variance (Levene's test) and Kolmogorov-Smirnov statistic (K-S). Distribution was assessed visually and from skewness and kurtosis in several instances as this is a more appropriate method than calculating significance in samples of over 200 (Field, 2009). Histogram, stem and leaf plot, boxplot, normal probability plot and detrended normal plot were used to explore assumptions graphically. Depending on whether assumptions were met or violated, appropriate parametric or non-parametric tests were used.

In general, analysis involved examining data on the CKI, CAI, MI and RTP to answer the research questions; 1) What do secondary school rugby players know about concussion? 2) How safe are secondary school rugby player's attitudes to concussion?

More specifically, the CKI and MI data was evaluated to answer question 1 about knowledge and the CAI and RTP data was used to answer question 2 about attitudes.

The first section of the results examined concussion knowledge by looking at percentages of correct and incorrect answers on the CKI and MI. For each index, the CAI, CKI and RTP, multiple regression was conducted to look at the difference in responding in participants subgroups. Multiple regression also indicated which variables or combinations of variables predicted the CKI, CAI and RTP total scores. Prior to multiple regression appropriate recoding and dummy coding of variables was carried out. The variables were age (11 to 19 years), gender (male or female), ethnicity (Māori, Pakeha or other), number of

years playing rugby (1 to 6 years), code played (union, league or both), experience of a concussion (yes or no), number of concussions sustained (1, 2, 3 or more than 3) and self-evaluation of whether participants knew enough about concussion (yes or no). When similar items appeared in different indices they were examined for an indication of consistency of responding. Data collected in the current study was compared to previous research, and finally, total concussion knowledge and attitude scores were correlated.

Chapter Three: Results

Concussion Knowledge

Of the 456 participants, only the responses of the 393 participants who answered every item of the CKI were included in analysis of the CKI. The mean score was 16.8 (*SD* = 3.42); range four to 24 (a higher score indicating better knowledge).

One of the two scales which comprised the CKI, required participants to identify post concussive symptoms (eight genuine symptoms and eight distractors) see Table 3. Results showed that on average participants could correctly identify 5.59 legitimate concussion symptoms (SD = 1.96, range one to eight) and 6.80 non legitimate concussion symptoms (SD =1.16, range one to eight). Table 3 shows the number and percentage of correct responses to each of these items. In terms of recognising actual symptoms, more than 80% of players knew that dizziness and headache were post-concussive symptoms. Feeling in a fog was the post concussive symptom which was recognised by the least number of participants. There was a mixed response to the other five actual symptoms which ranged from 51.9 to 77.9 %.

Six out of eight non-post concussive symptoms were recognised as such by more than 80% of participants. These were; an allergic rash, panic attacks, excessive studying, arthritis, weight gain and hair loss. The one non post-concussive symptom which more than half of participants thought was an actual post-concussive symptom was ‘difficulty speaking’ and which may be a consequence of more severe TBI.

Table 3: Symptom Answer, Number and % Correct (n=393)

Items	Answer	Number Correct	% Correct
Post-concussive symptoms			
Sensitivity to light	True	202	(51.4)
Feeling in a fog	True	137	(34.9)
Feeling slowed down	True	276	(70.2)
Dizziness	True	348	(88.5)
Headache	True	367	(93.4)
Difficulty remembering	True	295	(75.1)
Drowsiness	True	265	(67.4)
Difficulty concentrating	True	306	(77.9)
Not Post-concussive symptoms			
Allergic rash	False	371	(97.1)
Difficulty speaking	False	143	(37.4)
Panic attacks	False	323	(84.6)
Excessive studying	False	359	(94.2)
Arthritis	False	370	(97.1)
Weight gain	False	368	(95.8)
Reduced breathing rate	False	300	(78.1)
Hair loss	False	369	(96.3)

Knowledge was also evaluated through a second scale which asked for true/false responses to statements. Table 4 shows the responses to the True/False CKI items and summarises the number and percentage of correct answers to each of these items. Over 80% of participants answered items 1 and 8 correctly indicating that most players knew there is a possible risk of death if a second concussion occurs before a previous concussion has healed and that symptoms of concussion can last for several weeks.

Table 4: Correct Answers to True/False CKI Items. (n = 393)

CKI Items	Correct Answer	Number Correct	% Correct
1. There is a possible risk of death if a second concussion occurs before the first one has healed.	True	333	84.7
3. People who have had one concussion are more likely to have another concussion.	True	253	64.4
5. In order to be diagnosed with a concussion, you have to be knocked out.	False	335	85.2
6. A concussion can only occur if there is a direct hit to the head.	False	231	58.8
7. Being knocked unconscious always causes permanent damage to the brain.	False	261	66.4
8. Symptoms of a concussion can last for several weeks.	True	358	91.1
9. Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	False	320	81.4
11. After a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) typically shows visible physical damage (e.g., bruise, blood clot) to the brain damage (e.g., bruise, blood clot) to the brain.	False	96	24.4
12. If you receive one concussion and you have never had a concussion before, you will become less intelligent.	False	347	88.3
13. After 10 days, symptoms of a concussion are usually completely gone.	True	181	46.1
14. After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	False	146	37.2
16. Concussions can sometimes lead to emotional disruptions.	True	295	75.1
17. A player who gets knocked out after getting a concussion is experiencing a coma.	True	140	35.6
18. There is rarely a risk to long-term health and well-being from multiple concussions.	False	214	54.5
Scenario 1 *While playing in a game, Player Q and Player X collide with each other and each suffers a concussion. Player Q has never had a concussion in the past. Player X has had 4 concussions in the past.*			
1. It is likely that Player Q's concussion will affect his/her long-term health and well-being.	False	261	66.4
2. It is likely that Player X's concussion will affect his/her long-term health and well-being.	True	326	83
Scenario 2 *Player F suffered a concussion in a game. He/she continued playing in the same game despite the fact that he/she continued to feel the effects of concussion.*			
3. Even though Player F is still experiencing the effects of the concussion, his/her performance will be the same as it would be if he/she had not suffered a concussion.	False	297	75.6

Note. CKI=Concussion Knowledge Index

Knowledge was relatively poor for two items (13 and 17) where less than 50% of participants answered correctly, indicating that the majority of participants did not know that a player who gets knocked out is experiencing a coma and they were unaware that after 10 days symptoms of concussion are usually completely gone.

There was good knowledge around several items which were a false statement and were recognised as such by over 80% of participants (Table 4, items 5, 9 and 12). The majority or participants were aware that you didn't need to be knocked out to be diagnosed with a concussion, that a second concussion doesn't help a person remember things that were forgotten after the first concussion and one concussion does not alter your intelligence.

Over half of the participants were unaware that; after a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) does not typically show visible physical damage (e.g., bruise, blood clot) to the brain (Table 4, item 11), and that after a concussion people don't forget who they are and not recognize others but are perfect in every other way (Table 4, item 14).

Responses to the rugby scenarios (see Table 4) indicated that the majority of participants were aware that a player with previous concussions is more likely to suffer impairment of long term health and well-being than a player sustaining their first concussion (scenario 1) and that a player's long term health and well-being was likely to be affected after suffering 5 concussions (scenario 1, item 2). Over three quarters of participants were aware that playing on while suffering the effects of concussion would affect performance (scenario 2, item 3)

Table 5: Correct Answers to True/False MI Items. (n = 430 to 437)

17 Misconception Index Items	Answer	Number Correct	% Correct
1. Even after several weeks in a coma, when people wake up most recognize and speak to others right away	False	233	53.3
2. After a head injury, people can forget who they are and not recognise others but be perfect in every other way	False	115	26.6
3. Sometimes a second blow to the head can help a person remember things that were forgotten	False	332	77.2
4. How quickly a person recovers from head injury depends mainly on how hard they work at recovering	False	233	54.1
5. A person who has recovered from a head injury is less able to withstand a second blow to the head	True	295	68.1
6. Complete recovery from a severe head injury is not possible, no matter how badly the person wants to recover	True	252	57.9
7. People who have had one head injury are more likely to have a second one	True	251	57.8
8. After a head injury it is usually harder to learn than before the injury	True	205	47.7
9. A head injury can cause brain damage even if the person is not knocked out	True	354	81.8
10. Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head	True	325	75.2
11. Emotional problems after head injury are usually not related to brain damage.	False	247	57.3
12. Most people with brain damage look and act disabled.	False	270	62.6
13. When people are knocked unconscious, most wake up shortly after with no lasting effects.	False	236	54.5
14. People in a coma are usually not aware of what is happening around them.	True	332	76.9
15. People with amnesia/loss of memory for events before the injury, usually have trouble learning new things.	True	235	54.3
16. Once a recovering person feels ‘back to normal’ the recovery process is complete.	False	258	59.7
17. It is good advice to rest and remain inactive during recovery.	False	80	18.4

Note. MI=Misconception Index

Further knowledge of concussion related to participants misconceptions about head injury which were evaluated using the 17 item MI (8 true statements, 9

false statements). Table 5 shows MI items and the number and percentage of correct answers.

As can be seen, over 80% of participants knew that a head injury could cause brain damage even if the person is not knocked out (item 9). Fewer than half of participants knew that it is usually harder to learn after a head injury than before the injury (item 8).

Table 6: Means for CKI (n=393) and MI (n=430-437) scales across variables.

	True/False CKI scale	Symptom CKI scale	Total CKI	Total MI
Variable	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Gender				
Male	11.15(2.32)	12.56(1.88)	16.68(3.45)	24.53(2.41)
Female	11.50(2.16)	12.76(1.97)	17.68(3.08)	23.95(2.41)
Ethnicity				
Māori	10.88(2.37)	12.28(1.86)	15.94(3.21)	26.32(2.21)
Pakeha	11.51(2.31)	12.85(1.80)	17.43(3.33)	27.16(2.04)
Other	10.23(1.90)	11.77(2.05)	15.31(3.34)	26.24(2.06)
Code playing				
Union	11.28(2.28)	12.60(1.88)	16.87(3.42)	26.88(2.12)
League	10.87(2.23)	12.85(1.57)	16.40(3.60)	26.13(2.17)
Both	10.17(2.52)	12.21(2.11)	15.69(3.32)	26.83(2.04)
Ever had concussion?				
Yes	11.25(2.24)	12.82(1.75)	17.10(3.31)	24.68(2.17)
No	11.11(2.38)	12.33(2.00)	16.44(3.51)	24.28(2.61)
Know enough about concussion?				
Yes	11.46(2.36)	12.76(1.82)	17.26(3.45)	24.65(2.31)
No	10.94(2.24)	12.42(1.93)	16.36(3.36)	24.33(2.49)

Note. CKI=Concussion Knowledge Index. MI=Misconception Index

The majority of participants wrongly thought that after a head injury, people can forget who they are and not recognise others but be perfect in every

other way (Table 5, item 2) and it is good advice to rest and remain inactive during recovery (Table 5, item 17).

Table 6 shows the mean responding for the two scales on the CKI, the two scales combined and the MI. It shows which groups of variables scored higher or lower than others. Females had slightly higher scores on the CKI but not on the MI. However, all results for gender are interpreted with caution due to the relatively low number of female participants (Males N = 409, Female N = 47). Those of Pakeha ethnicity had higher scores on all knowledge indices. Rugby Union players had higher scores overall on the CKI and MI than those who played rugby league. Yet, rugby league players had higher scores around symptoms. It was clear that players who had experienced a concussion secured higher scores across all measures than those who had not. Self-rating of concussion knowledge showed that those who thought they knew enough did actually score higher than those who felt they did not know enough. Between group comparisons were not carried out as variables were included in correlation and multiple regression analyses to explore significant difference. This is reported on later here.

For the CKI, two-tailed correlations (see table 7) confirmed the there was a significant relationship between the self-rating of concussion knowledge. Those who rated themselves as knowing enough, did know significantly more than those who self-rated as not knowing enough. Correlation analysis also confirmed that ethnicity impacted concussion knowledge with those identifying with Pakeha ethnicity having significantly better knowledge that those identifying as Māori or other ethnicity on both measures of knowledge. Also, as the number of concussions sustained increased so did knowledge as measured by the MI scale (see table 7).

Table 7: Pearson Correlation Coefficients for the CKI (n=393), CAI (n=426), MI (n=430-437) and RTP (n=435) with all demographic and related variables.

Variables	CKI	MI	CAI	RTP
Age (11 to 19 years)	.08	.07	-.05	-.06
Gender (Male = 0, Female = 1)	.08	.00	.04	.04
Number of years of play (1 to 5 years)	.10	.08	.02	.01
Code played				
Union and League	-.09	.00	.09	.06
Union and Both	-.02	-.07	-.06	-.05
Ever experienced concussion? (Yes = 0, No = 1)	-.10	-.09	-.07	-.11*
How many concussions experienced? (1, 2, 3, 3+)	-.05	.15*	-.09	-.07
Know enough about concussion? (Yes = 0, No = 1)	-.13**	-.07	-.09	-.09
Ethnicity				
Pakeha and Māori	-.12*	-.13**	-.22**	-.21**
Pakeha and Other	-.21**	-.12*	-.02	-.05

Note. CKI=Concussion Knowledge Index, CAI=Concussion Attitude Index, MI=Misconception Index, RTP=Return to Play Index
* = significant at the 0.05 level (2-tailed) ** = significant at the 0.01 level (2-tailed)

A multiple linear regression was conducted to predict total CKI scores based on the demographic variables and other related variables. Similar analyses was carried out for the CAI, MI and RTP indices. In all cases, variables were entered simultaneously in one block as previous research had not identified a clear theoretical basis for selection. Relevant assumptions of this analysis were met for the CKI data and a significant regression equation was found ($F(10,189) = 2.63$, $p < .01$), with an R^2 of .12.

Table 8: Multiple Regression for Total CKI Scores (n=393)

	B	SE B	β
Constant	17.33	2.68	
Age	0.41	0.19	.02
Gender	1.54	0.80	.14
Years of play	0.16	0.19	.08
Ever had concussion?	-0.52	0.49	-.08
How many concussions?	-0.25	0.27	-.07
Know enough about concussion?	-0.79	0.49	-.11
Ethnicity			
Pakeha v Māori	-1.32	0.61	-.16*
Pakeha v Other	-2.37	0.68	-.25**
Code of rugby played			
Union v League	-0.81	0.90	-.06
Union v Both	-0.43	1.28	.03

Note: R^2 = .12, * p = < .05, **p = < .01. CKI=Concussion Knoweldge Index.

Ethnicity was a significant predictor of concussion knowledge on the CKI. Being of Pakeha ethnicity predicted better concussion knowledge than being of Māori or 'other' ethnicity. Results of the CKI multiple regression for all variables are shown in Table 8.

Table 9: Multiple Regression for MI Total Scores (n=430 to 437)

	B	SE B	β
Constant	25.36	1.67	
Age	0.09	0.12	.06
Gender	0.26	0.51	.04
Years of play	0.01	0.12	.01
Ever had concussion?	-	-	-
How many concussions?	0.35	0.17	.15*
Know enough about concussion?	-0.16	0.31	-.04
Ethnicity			
Pakeha v Māori	-0.87	0.38	-.17*
Pakeha v Other	-0.91	0.44	-.16*
Code of rugby played			
Union v League	0.29	0.57	.04
Union v Both	-0.56	0.82	-.05

Note: R^2 = .07, * p = < .05. MI=Misconcepton Index.

MI total scores were the dependent variable for a further multiple linear regression analysis to predict concussion knowledge as indicated by total MI scores based on the demographic variables and other related variables. Relevant assumptions for this analysis were again met. A non-significant regression equation was found ($F(9,185) = 1.65$, $p > .05$), with an R^2 of .07. Significant predictors of MI concussion knowledge were ethnicity, and the number of concussions experienced. Being of Pakeha ethnicity rather than of Māori ethnicity predicted better knowledge and as players experienced more concussion their knowledge of concussion improved. Results of the MI multiple regression for all variables are shown in Table 9.

Consistency of Responding To Knowledge Items

There were four items which appeared twice in the overall survey. In some cases they were worded slightly differently but still related to the same area of knowledge and were used to evaluate consistency of knowledge and reliability of responding. Table 10 shows the items which appeared twice. Analysis was carried out to see if there was a significant correlation of responses on the pairs of items (see Table 10). Cronbach's Alpha was also reported as an indicator of reliability. Both Cronbach's Alpha and Pearson's *r* were relatively low and indicated poor reliability and consistency of responding. This could be because of the different wording of the items and the inconsistent use of terminology for TBI.

Table 10: Similar Item Responding Compared. (CKI n=393, MI n=430 to 437)

Pair	Item	Scale	Answer	Number correct	% correct	α	*r*
Pair 1	People who have had one concussion are more likely to have another concussion.	CKI	True	253	64.4	.57	.39
	People who have had one head injury are more likely to have a second one	MI	True	251	57.8		
Pair 2	Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	CKI	False	320	81.4	.37	.23
	Sometimes a second blow to the head can help a person remember things that were forgotten	MI	False	332	77.2		
Pair 3	After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	CKI	False	146	37.2	.41	.26
	After a head injury, people can forget who they are and not recognise others but be perfect in every other way	MI	False	115	26.6		
Pair 4	There is rarely a risk to long-term health and well-being from multiple concussions.	CKI	False	214	54.5	.11	.06
	It is likely that player X's (5^{th}) concussion will affect his/her long-term health and well-being.	CKI	True	326	83		

Note. CKI=Concussion Knowledge Index. MI=Misconception Index.

Attitudes to Concussion

Rugby player's attitudes to concussion were evaluated using the CAI. The CAI items had two safe, one neutral and two unsafe response options. Responses were scored from one to five depending on the level of safety of participants' choice of answer. Higher CAI scores indicated safer attitudes around concussion.

Only the scores of the 426 participants who answered every attitude item were included in analyses of attitude measures. The participants average score on this scale was 57 (*SD* = 7.73, range 36 to 75). Table 11 shows the CAI items and the number and percentage of participants who chose safe and unsafe responses for each item.

Overall, the majority of participants picked the safe item response for 14 of the 15 CAI items and only a small percentage (< 20%) picked the unsafe response for 14 of the 15 items. The percentage of respondents who picked the neutral response ranged from 11% to 35.9%. The highest percentage, over 80%, of participants chose the safer response on one item on the CAI which showed that a large majority felt it was safer to keep a concussed player out of the game even though the team went on to lose (scenario 1, item 1).

The items following each of the four CAI scenarios asked for participants to consider their own subjective response and then the predicted response of 'most players.' In every case the participant's self-reported attitudes were safer than those predicted of 'most players.' Analysis indicated this difference was significant. On average, participants own attitudes were safer (M = 19.56, SD = 3.30) than what they felt others attitudes would be (M = 18.04, SD = 3.04), $t(424) = 10.52$, $p < .05$, $r = .46$. In reality the average difference was a score of 1.52. Although this seems relatively minimal, *r* indicates a medium to large effect size.

Table 11: CAI Safe and Unsafe Responses. n = 426.

	CAI Items	n(%) safe	n(%) neutral	n(%) unsafe
1	I would continue playing rugby while also having a headache that resulted from a concussion.	248(58.3)	89(20.9)	89(20.9)
2	I feel that coaches need to be extremely cautious when determining whether a player should return to play. (RTP)	338(79.3)	69(16.2)	19(4.5)
5	I feel that concussions are less important than other injuries.	290(68.1)	107(25.1)	29(6.8)
6	I feel that a player has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion. (RTP)	302(70.9)	93(21.8)	31(7.3)
7	I feel that any player that is knocked unconscious should be taken to the emergency room.	287(67.6)	107(25.2)	31(7.3)
Scenario 1				
Player R suffers a concussion during a game. Coach A decides to keep Player R out of the game. Player R's team loses' the game.				
1	I feel that Coach A made the right decision to keep Player R out of the game. (RTP)	351(82.4)	47(11)	28(6.6)
2	Most players would feel that Coach A made the right decision to keep Player R out of the game.	281(66)	98(23)	47(11)
Scenario 2				
Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semi-final playoff game. Both athletes had persisting symptoms.				
3	I feel that player M should have returned to play during the first game of the season. (RTP)	298(70.1)	97(22.8)	30(7.1)
4	Most players would feel that player M should have returned to play during the first game of the season.	250(58.8)	125(29.4)	50(11.8)
5	I feel that player O should have returned to play during the semi-final playoff game. (RTP)	270(63.5)	120(28.2)	35(8.2)
6	Most players would feel that player O should have returned to play during the semi-final playoff game.	210(49.4)	143(33.6)	72(16.9)
Scenario 3				
Player R suffered a concussion. Player R's team has an athletic trainer on the staff.				
7	I feel that the athletic trainer rather than Player R should make the decision about returning Player R to play. (RTP)	242(56.8)	116(27.2)	68(16)
8	Most players would feel that the athletic trainer rather than Player R should make the decision about returning Player R to play.	216(50.7)	153(35.9)	57(13.4)
Scenario 4				
Player H suffered a concussion and he/she has a *game in two hours. He/she is still experiencing symptoms of concussion. However, player H knows that if he/she tells his/her* coach *about the symptoms, the coach will keep him out of the game*				
9	I feel that Player H should tell his/her coach about the symptoms. (RTP)	321(75.4)	81(19)	24(5.6)
10	Most players would feel that Player H should tell his/her coach about the symptoms.	264(61.9)	119(27.9)	43(10.1)

Note. (RTP) = item is included on the return to play index. CAI=Conussion Attitude Index.

Responding to two items indicated that when there was a difference in the importance of a match there was a difference in the attitude to playing on while concussed. In scenario 2 more participants felt a concussed player should return to the game when it was a semi-final play-off (item 5) than when it was the first game of the season (item 3).

Also the least safe response in the CAI was to an item which asked participants to consider what 'most players' would think of a scenario and showed that more than half of participants felt 'most players' would want a concussed player to play on in a match of more importance, a semi-final play-off match (scenario 2, item 6).

There was a relatively even split of responding around who should make the decision to return to play; an athletic trainer or the injured player. Slightly more participants felt an athletic trainer should make the return to play decision rather than the injured player (scenario 3, item 7). Participants predicted that 'most players' would be evenly divided about whether the athletic trainer or injured player made the return to play decision (scenario 3, item 8).

It was encouraging that more than half of participants disagreed with continuing play while suffering a concussion related headache (item 1). It was also encouraging that three quarters of participants felt that a player should tell a coach of continued concussion symptoms even though he/she may be kept out of an imminent game (scenario 4, item 9). This attitude was consistent in another item (item 6) where just under three quarters of participants disagreed that a player was responsible for returning to a game while experiencing concussion symptoms.

Table 12 shows how mean responding differed on concussion attitude measures across variables. Although the influence of gender was explored, and showed females had safer attitudes than males, results are again interpreted with appropriate caution because of the unequal sample size (Males N = 409, Female N = 47). The safest attitudes were evident in those who identified with Pakeha ethnicity compared to players of Māori or 'other' ethnicity. Participants who played both rugby union and league had safer attitude scores than those who just played one of the codes. Experiencing a concussion meant players had safer attitude scores as did believing that you know enough about concussion.

Table 12: CAI (n=426) and RTP (n=435) Total Mean Scores by Demographic Variables

	Total CAI (N=426)	Total RTP (N=435)
Variable	Mean (SD)	Mean (SD)
Gender		
Male	56.90(7.93)	27.57(4.36)
Female	57.86(5.85)	28.10(3.18)
Ethnicity		
Māori	53.74(7.68)	25.90(4.22)
Pakeha	58.15(7.20)	28.32(4.02)
Other	56.69(8.70)	27.13(4.54)
Code playing		
Union	56.90(7.53)	27.59(4.19)
League	54.47(9.28)	26.50(4.59)
Both	59.34(9.03)	28.47(4.75)
Ever had concussion?		
Yes	57.57(7.90)	28.09(4.34)
No	56.47(7.57)	27.19(4.14)
Know enough about concussion?		
Yes	57.80(7.96)	28.04(4.39)
No	56.37(7.52)	27.29(4.12)

Note. CAI=Concussion Attitude Index. RTP=Return To Play Index.

Two-tailed correlation analysis of the CAI (see table 7) indicated that ethnicity was the only variable showing a significant relationship, with those identifying as Pakeha having safer attitude scores than those identifying as Māori. Ethnicity had the same impact on attitude to RTP and there was also a significant difference depending on experience of a concussion. Those who had sustained a concussion had safer attitude scores than those who had not.

Table 13: Multiple Regression For CAI Total Score. (n=426)

	B	SE B	β
Constant	65.29	6.03	
Age	-0.42	0.43	-.09
Gender	1.93	1.80	.08
Years of play	0.36	0.42	.08
Ever had concussion?	-0.80	1.09	-.05
How many concussions?	-0.74	0.60	-.09
Know enough about concussion?	-0.93	1.10	-.06
Ethnicity			
Pakeha v Māori	-4.55	1.36	-.24**
Pakeha v Other	-1.53	1.53	-.07
Code of rugby played			
Union v League	3.18	2.02	.11
Union v Both	-0.76	2.89	-.02

Note: R^2 = .09, **p = < .01. CAI=Concussion Attitude Index

A multiple linear regression with all variables entered simultaneously was conducted for the total score on the CAI as the dependent variable. Assumptions were again met. A significant regression equation was found ($F(10, 197) = 1.96$, $p < .05$), with an R^2 of .09. Ethnicity was the only significant predictor of

concussion attitude with those of Pakeha ethnicity having significantly better concussion knowledge scores than those of Māori ethnicity. Results of the CAI multiple regression for all variables are shown in Table 13.

Return To Play

A specific area of interest was attitude to returning to play rugby after experiencing a concussion and/or post-concussive symptoms. The RTP index comprised seven items (see Table 14) which directly referred to the participant's attitude to returning to play. Although these items were a subset of the CAI they were categorised as the RTP and analysed as slightly more participants answered the seven RTP items (n=435) than the CAI items (n=426), therefore analysis yielded slightly different results.

The mean RTP score was 27.62 (*SD* = 4.3), the range of possible scores was 7 to 35. Table 14 shows the items and the number and percentage of participants who chose safe and unsafe responses. The safe answer option was selected by over half of participants for all seven items.

Table 15 also shows most participants agreed with; a coach keeping a concussed player out of a game even though the game was lost (scenario 1, item 1), coaches being extremely cautious when considering whether a player should return to play (item 2), and reporting concussion symptoms to coaches even if it could mean being kept out of a game (scenario 4, item 9). Less players thought that a concussed player should return to play during the first game of the season than during a semi-final.

The least safe attitudes were around who should make a decision about returning to play, an athletic trainer or a concussed player (scenario 4, item 9).

Table 14: RTP Safe and Unsafe Responses. (n = 435)

RTP Items	n(%) safe	n(%) neutral	n(%) unsafe
2. I feel that coaches need to be extremely cautious when determining whether a player should return to play.	347(79.8)	69(15.9)	19(4.4)
6. I feel that a player has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	306(70.4)	96(22.1)	33(7.6)
Scenario 1			
Player R suffers a concussion during a game. Coach A decides to keep Player R out of the game. Player R's team loses' the game.			
1. I feel that Coach A made the right decision to keep Player R out of the game.	360(82.8)	47(10.8)	28(6.4)
Scenario 2			
Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semi-final playoff game. Both athletes had persisting symptoms.			
3. I feel that player M should have returned to play during the first game of the season.	303(69.7)	100(23)	32(7.4)
5. I feel that player O should have returned to play during the semi-final playoff game.	275(63.2)	122(28)	38(8.7)
Scenario 3			
Player R suffered a concussion. Player R's team has an athletic trainer on the staff.			
7. I feel that the athletic trainer rather than Player R should make the decision about returning Player R to play.	247(56.8)	117(26.9)	71(16.3)
Scenario 4			
Player H suffered a concussion and he/she has a *game in two hours. He/she is still experiencing symptoms of concussion. However, player H knows that if he/she tells his/her* coach *about the symptoms, the coach will keep him out of the game*			
9. I feel that Player H should tell his/her coach about the symptoms.	328(75.4)	82(18.9)	25(5.7)

Note. RTP=Return to Play Index.

The safer option of the athletic trainer making the decision was selected by a little over half the participants.

Table 12 shows mean RTP scores across variables and although the influence of gender was explored, results were again interpreted with

appropriate caution because of the unequal sample size. Mean RTP scores followed the same pattern across variables as those for the CAI.

Players identifying as Pakeha ethnicity had the safest attitudes followed by those identifying with 'other', followed by those identifying as Māori. These findings followed the trend previously reported for other indices where a significant difference in concussion knowledge and attitude was found between players of different ethnicity.

Assumptions were met for a similar multiple linear regression for attitudes to return to play. This showed a significant regression equation ($F(10, 201) = 1.95$, $p < .05$), with an R^2 of .09. Ethnicity was the only significant predictor of attitude to return to play, with those of Pakeha ethnicity predicted to have safer attitudes to RTP than those of Māori ethnicity.

Results of the RTP multiple regression for all variables are shown in Table 15.

Table 15: Multiple Regression for RTP Total Score (n=435)

	B	SE B	β
Constant	32.90	3.29	
Age	-0.26	0.23	-.10
Gender	1.09	0.98	.08
Years of play	0.15	0.23	.06
Ever had concussion?	-0.83	.60	-.10
How many concussions?	-0.29	0.33	-.06
Know enough about concussion?	-0.44	0.60	-.05
Ethnicity			
Pakeha v Māori	-2.46	0.74	-.24**
Pakeha v Other	-1.26	0.83	-.11
Code of rugby played			
Union v League	1.24	1.10	.08
Union v Both	-0.10	1.58	.00

Note: $R^2 = .09$, **p = < .01. RTP=Return To Play Index.

Correlation Between Knowledge and Attitude

The total scores for overall concussion knowledge and overall concussion attitude were correlated. Results showed there was a significant positive relationship between knowledge and attitude r = .12, *p* (2-tailed) < .05. This meant that as knowledge of concussion increased so did the safety of attitudes towards concussion. The symptom scale of the CKI and the CAI scores were correlated and there was non-significant relationship r = .09, p (2-tailed) > .05 which indicated that good knowledge of symptoms did not necessarily lead to safer attitudes to concussion.

MI Comparison to Previous Studies

Versions of the MI have been used in previous research. The items which were used in previous research and the current research are shown in Table 17. Missing columns indicate where an item was not included in a study. Details of previous studies are shown in Table 16 and percentage of correct responses are shown in Table 17 for all studies. This data allows a comparison of concussion knowledge in lay people in other studies and secondary school rugby players in the current study. Results are considered further in the discussion chapter.

Some patterns of responding can be seen across the data. The current study participants had the best knowledge of all study groups on 6 out of the 17 items (5, 7, 8, 9, 12, and 13) and had the poorest knowledge on 4 items (3, 4, 6, and 16). Far fewer respondents in the current study knew it was false to say that most people with brain damage look and act disabled, emotional problems after a head injury are not related to brain damage, and once the recovering person feels back to normal, the recovery process is complete, compared to the Hux et al. (2006) study. Compared to the previous 5 groups surveyed, the current study participants

were the least knowledgeable that it was false to say that even after several weeks in a coma, when people wake up, most recognise and speak to others right away (item 6). The range of responding was the biggest for item 17 where there was a difference of 57.31 % between the best knowledge (27.99%) and the poorest knowledge (85.30%). This indicated an inconsistency in knowledge about complete recovery from a severe head injury not being possible, no matter how badly the person wants to recover. There was also a wide range of responses for items 15 and 16 which showed people have varying degrees of knowledge about the statement 'once a recovering person feels 'back to normal' the recovery process is complete' and 'it is good advice to remain inactive during recovery.'

The best knowledge of all items was for item 1 which indicated it is well known that a head injury can cause brain damage even if the person is not knocked out. The poorest overall knowledge was reported for item 8 indicating there was a persistent incorrect belief in the samples surveyed that 'after a head injury, people can forget who they are and not recognise others but be perfect in every other way'. However, more of the current participants realised that this was a false statement than participants in any of the previous studies.

Although the current study participants had the best knowledge on items 5 and 10, correct responding was at approximately 50% across all studies. There was generally poor knowledge around item 11 across all studies which showed people generally did not know that after a head injury it is usually harder to learn than before the injury. For items 12 and 13, although the current study participants had the best knowledge, all responding across studies was generally below the 50% level. Item 14 responses showed that the majority of participants across all

six studies knew that a person who has recovered from a head injury is less able to stand a second blow to the head.

Table 16: Details of Previous and Current Research Studies

	Gouvier et al.	Willer et al.	Guilmette et al.	Hux et al.	Current study
Year of study	1988	1993	2004	2006	2014
Journal	Archives of Clinical Neuropsychology	Archives of Clinical Neuropsychology	Archives of Clinical Neuropsychology	Brain Injury	Unpublished master's thesis
Number of participants	221	245/68	179	318	456
Type of participants	Lay public	Lay public	Lay public	Lay public	Secondary school rugby players
Participant age	15 years +	Adults	adults	adults	11 to 19 years
Participant context	Shopping mall	Shopping mall	Motor vehicle department	Regional shopping malls	Secondary schools
State or city of study	Louisiana	New York/Ontario	New England	Not specified	Nationwide
Country of study	USA	USA/Canada	USA	USA	New Zealand

Table 17: Items and Correct Response Percent in Previous and Current Studies

	Item	Gouvier et al 1988	Willer et al. 1993 WNY[a]	Willer et al. 1993 ONT[b]	Guilmette et al. 2004	Hux et al. 2006	Current study 2014
		Percentage of correct response					
1.	A head injury can cause brain damage even if the person is not knocked out. T	72.85			91.70	98.75	81.80
2.	Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head. T	54.75			64.30	90.25	75.20
3.	Emotional problems after head injury are usually not related to brain damage. F	74.21				83.65	57.30
4.	Most people with brain damage look and act disabled. F	69.23				94.03	62.60
5.	When people are knocked unconscious, most wake up shortly with no lasting effects. F	40.72				51.89	54.50
6.	Even after several weeks in a coma, when people wake up most recognize and speak to others right away. F	58.82	82.00	83.80	59.70	76.42	53.30
7.	People in a coma are usually not aware of what is happening around them. T	67.87				40.25	76.90
8.	After a head injury, people can forget who they are and not recognise others but be perfect in every other way. F	17.65	11.00	17.60	25.00	6.60	26.60
9.	Sometimes a second blow to the head can help a person remember things that were forgotten. F	54.30	62.40	60.30	58.20	71.38	81.80
10.	People with amnesia for events before the	57.01				51.89	54.30

	injury, usually have trouble learning new things. T						
11.	After a head injury it is usually harder to learn than before the injury. T	49.32	48.60	35.30	64.20	51.52	47.70
12.	How quickly a person recovers from head injury depends mainly on how hard they work at recovering. F	29.86	46.90	41.20		47.48	54.10
13.	People who have had one head injury are more likely to have a second one. T	26.24	18.80	11.80	31.90	32.08	57.80
14.	A person who has recovered from a head injury is less able to withstand a second blow to the head. T	83.26	65.70	67.60	63.20	70.13	68.10
15.	Once a recovering person feels 'back to normal' the recovery process is complete. F	52.94				97.48	59.70
16.	It is good advice to rest and remain inactive during recovery. F	39.37				60.06	18.40
17.	Complete recovery from a severe head injury is not possible, no matter how badly the person wants to recover. T	42.08	85.30	82.40	39.70	27.99	57.90

Note: T = True, F = False. [a] = Western New York State, [b] = Southern Ontario.

For item 7, almost twice as many respondents in the current study than in the Hux et al. study knew that people in a coma are usually not aware of what is going on around them. The pattern was similar for item 13 (people who have had one concussion are more likely to have a second one) and item 17 (complete recovery from a severe head injury is not possible, no matter how badly the

person wants to recover) where the current study knowledge was almost double that of the Hux et al. (2006) study. However knowledge of item 17 had not reached the previous highs of both participant groups in the Willer et al. (1993) research.

Chapter Four: Discussion

Rugby is a popular sport in New Zealand and Rugby Union is the second most played sport in secondary schools in 2013 behind outdoor netball (NZSSSC, 2014). The risk of TBI in the rugby playing population is high (Theadom et al. 2014) and there has recently been a swell of interest in mainstream media and academic research around many aspects of concussion in rugby. Research has validated the concerns showing there were more ACC (www.acc.co.nz) claims for moderate to severe concussion than any other sport during a 10 year period from 2001 (King et al. 2013).

In spite of this high incidence little is known about the knowledge and attitude of the secondary school rugby playing population who are particularly vulnerable to concussion because of the contact nature of the sport, and the maturational stage of the brain which is still developing during the teenage years. Therefore this research aimed to answer the questions - what do secondary school rugby players know about concussion and what are their attitudes to concussion? This was implemented through a nationwide sample of 456 secondary school players who were playing rugby union or league during 2014 and completed a survey about knowledge of, and attitude towards concussion.

Knowledge of symptoms seems to be important in providing a basis for broader concussion knowledge and attitudes and encouragement could be drawn from the symptom knowledge section of the survey in which a majority of respondents recognised 7 out of 8 actual post-concussive symptoms and 7 out of 8 non-post concussive symptoms. Results showed that good symptom knowledge did not necessarily lead to more reporting of concussion, and careful rehabilitation

but the findings of good symptom knowledge are nevertheless a positive starting point from which to improve concussion knowledge and attitude.

Williams (2013) found similarly good knowledge in English soccer players, particularly that the most well-known symptoms identified by both groups were headache and dizziness. Good symptom knowledge, again particularly around headache and dizziness, was also the case for student coaches at a university level coaching course in America (Saunders, Burdette, Metzler, Joyner & Buckley, 2013), and university athletes in an American sample (Register-Mihalik et al, 2013). Symptom knowledge was at an 'inappropriate' level for a sample of Florida university football players (Cournoyer & Tripp, 2014) and was 'mixed' for Italian club level football (soccer) coaches (Broglio et al. 2010). Differing methodology which included differences in lists of concussion symptoms and distractor symptoms could be contributing to variances in symptom knowledge along with other factors.

The symptom which was not spotted by the majority of current participants was 'feeling in a fog.' It could be argued that this item is ambiguous and there may have been mixed interpretation of its meaning. The one non post-concussive symptom which more than half of participants thought was an actual post-concussive symptom was 'difficulty speaking.' This result is perhaps understandable and a reflection of research since the concussion list was devised which identifies difficulty speaking as an actual post concussive symptom (McCrory et al., 2005). Among contemporary information available to the public, The LAPSA Speech Language (www.lapsespeeshlanguage.com) and American Association of Neurological Surgeons (www.aans.org) websites also list speech difficulties among post concussive symptoms.

It is of some concern that although over 80% of participants knew there was a possible risk of death if a second concussion occurred before a previous one had healed, participants thought the majority of their peers would be in favour of returning to play with concussive symptoms if the game had important consequences, such as a semi-final. It seems that at times rugby takes priority over health in this secondary school population. However, this is tempered somewhat by the finding that personal attitudes to returning to play with concussive symptoms were much safer than the perceived attitude of others and this trend was consistent throughout all items which asked about personal attitudes and the attitudes of 'others'. Also encouraging were relatively safe attitudes around playing on with a post concussive headache, reporting concussion and player responsibility for playing while concussed.

The current findings about attitudes being riskier as the importance of the game increased were also found by Sye et al. (2006) in another New Zealand secondary school rugby playing sample. However, a smaller proportion of the Sye et al. (2006) participants (27%) endorsed this risky attitude than in the current study. Williams (2013) found English soccer playing participants had relatively safe attitudes towards managers' keeping concussed players out of play, but only if the game was not of high importance, such as a semi-final, which was the same with the current New Zealand participants.

Of concern was the attitude in the previous New Zealand secondary school sample (Sye et al. 2006) and the current sample around who should make a decision to return to play following concussion. Sye et al. (2006) found that 52% of their sample made their own decision to return to play and in the current sample around half thought an athletic trainer should make the decision while the

remaining half comprised those who would make their own decision or were 'neutral' on the topic. It is not known how long after sustaining concussion the players made their return to play decision nor if they had followed the International Rugby Board, mandatory stand down and the NZRU directive that they must be symptom free and medically cleared before returning to play (www.coachingtoolbox.co.nz). The Sye et al. (2006) study did show that only a small number of concussed players sought medical clearance before returning to play. It would be important to gather this information in any future research which looks at returning to play after concussion.

It was encouraging that there was consistently good knowledge in secondary school players around the potential impairment to health and well-being after one concussion and that risk of impairment increased with subsequent concussion. Participants supported this awareness with good knowledge about how impairment might manifest which included effects on rugby performance, emotional behaviour, learning ability and some aspects of memory. It is hoped that knowledge about these matters would have a positive influence on attitudes and this study did find that overall as knowledge increased, so did the safety of attitudes. Of course it is unknown whether good knowledge and safe attitude translates to more reporting of concussion or to safer behaviours generally and therefore makes the link between knowledge, attitude and subsequent behaviour a relevant focus for future research.

Knowledge was also significantly better for those who self-rated themselves as knowing enough about concussion than those who felt they didn't know enough. It is not known where this knowledge was derived from but could indicate that when concussion information becomes available either through

personal experience, education or other avenues, players recognise their learning and feel confident enough to acknowledge this learning.

As the number of concussions experienced increased so did participant knowledge on the MI measure. This is encouraging because it indicates that as participants experience concussion there is some mechanism which increases their knowledge about it. However at the same time it is discouraging that personal experience of multiple concussion is one of the few things that increase concussion knowledge. Increased knowledge prior to sustaining multiple concussion would be preferable.

Of all the misconceptions around concussion, the statement about rest and recovery was the one endorsed by the most participants when it appeared on the MI scale. This could be because the item was not clear about what degree of rest and inactivity it was referring to and contemporary guidelines for concussion recovery do advise some degree of rest and inactivity and a graduated return to exercise, closely linked to the progression of symptom remission (McCrory, 2009a). In the past, recommendations to rest after concussion have generally meant reducing physical activity but more recently included cognitive rest (McCrory, et al., 2009a). Therefore it is debateable whether this item can be answered with a simple true or false and it is unknown to what extent players and others involved in coaching and management are aware of this and have potentially been passing information on to players.

Also linked to rehabilitation practice was the finding that almost half of participants thought concussion recovery was linked to how hard a person worked at it. It is concerning that those around a person suffering from TBI

may be unaware about safe rehabilitation practice and may be erroneously judging the person's recovery on how hard they are working at it. If recovery is not evident those around may not offer appropriate support as they think the concussed person is not recovering because of lack of motivation, laziness or apathy. Of further concern regarding rehabilitation was the finding that the majority of participants did not know that symptoms are usually completely gone after 10 days post-concussion. This means that players could be unaware that it is unusual to still be experiencing concussion symptoms past 10 days. It is important that they know this so that if symptoms persist beyond 10 days they will know to seek medical help.

On average, the New Zealand rugby sample (mostly aged 18 years and under) had better concussion knowledge than the English football playing sample (Williams, 2013) (all over 18 years old) but this was reversed for attitudes with the English sample having safer attitudes to concussion. One explanation for this could be the rise in concussion education strategies in New Zealand leading to better knowledge and the older age of English participants leading to safer attitudes. However it is likely that a more complex interplay of factors is responsible. In both samples the majority were unaware that brain imaging techniques do not show damage representing concussion. This is concerning because a player who is assessed using brain imaging techniques is likely to erroneously measure the extent of injury by the visual signs of damage including assuming there is no damage if the scan is clear. This could lead to a disregard and misunderstanding of subsequent symptoms and a lack of safe recovery and rehabilitation practices.

Other research has incorporated the MI in surveys and a comparison of results are shown in Table 17 in the results chapter. It is difficult to know what is underpinning the concussion knowledge in these studies and it could include age, location, exposure to relevant experience, education, and many other variables.

In the current study, the findings that ethnicity was a significant variable influencing all indices of knowledge and attitude was concerning. Those identifying as Māori and 'other' ethnicity generally had poorer knowledge and less safe attitudes than those identifying as Pakeha ethnicity, with those of Māori ethnicity having the least knowledge and least safe attitude of all participants on all indices. This could play a part in seeking health care for TBI in those of Māori ethnicity (Feigin et al. 2013) and adds to the overall vulnerability of this population to TBI.

It was not possible to reliably interpret findings for any ethnic groups in the 'other' category as this was a heterogeneous group including 19 different ethnicities which were each represented by small participant numbers (< 3.1% of total sample). Similarly, results for gender (females generally had better knowledge and safer attitudes than males) were considered unreliable due to a predominance of males and lack of females in the sample. The impact of gender and of being of minority ethnicity (<3.1%) are areas worthy of further exploration but have not been researched in any of the literature reviewed by the author.

It is possible that the areas of better knowledge and safer attitudes were due to either personal experiences of concussion or the experience of a team mate, as approximately half of the participants in this study and Williams' (2013) study had sustained a concussion.

Limitations and Strengths

This research relies on a self-report measure for gathering information for analysis. Although self-report is the most frequently used tool for measurement in psychology, its limitations are widely discussed (Haeffel & Howard, 2010). An obvious basis for the arguments pointing out the weakness of self-report is that it is a subjective rather than objective measure and as such susceptible to demand characteristics and potential bias. These influences could include social desirability where the respondents chose an answer they believe will help them to look good or fit in socially.

When schools were contacted and invited to distribute this survey, successful distribution relied on a positive response from a person at the school. The responses came from various school staff including administration staff, teachers, the school principal and board of trustee members. A negative response was often explained as being due to a lack of time to attend to the distribution. By all accounts, life in New Zealand secondary schools is busy and allocation of time has to be prioritised. Unsolicited research requests often seemed to be a low priority. This meant that a large number of potentially willing participants could not be invited to take part because of the gatekeeper role and understandable time limitations of the school based decision maker. Some other ways of accessing these potential participants were described in the ‘method’ section. Although there was still a substantial untapped population of eligible players the sample size of 456 respondents was substantial.

The choices of filling in the survey on paper or online could have limited the range of participants to those who are motivated to engage with these methods of communicating or have the required internet access and excluded those who

were disinclined to participate in this way or lacked relevant electronic resource (Evans & Mathur, 2005). It is well known that the participant age group favours mobile phone applications and online social media and survey distribution through these mediums may have resulted in a larger, more representative sample. To align with preferred social media usage the survey could have been advertised through popular mediums such as Facebook and Instagram. It may have been useful at the pilot stage of the study to ask pilot participants what online social media networks they used the most and for their suggestions on how the survey could be best advertised and distributed to their peers.

The ambiguity of some items and the interchangeable use of different terminology for TBI was a limitation. Consistency of responding was poor across four pairs of similar items but this could have been because the items were worded differently and TBI terminology varied across items. Providing information for participants about the definition of different terminology used in the survey or using one term, such as concussion, throughout the survey could have helped to improve consistency of interpretation and therefore consistency of responding.

Although the survey looked at knowledge and attitudes, and several items referred to behaviour, it is unknown to what extent the responses translate to actual behaviour, if at all. Also knowledge and attitude to concussion in females could not be reliably included in analysis due to the small number of female participants. It would also have been helpful to ask participants about their sources of knowledge. These are all relevant topics for future research.

Strengths of the study included the relatively large sample size (456) which included a relatively high percentage of participants who identified as

Māori ethnicity. A further strength was the availability of a Māori language translated version of the study and a review of the study by a researcher of Māori ethnicity. The survey was available online and on paper which made it accessible to all.

Practical Implications

It is clear that culturally sensitive and culturally appropriate educational strategies are a high priority, in terms of both the development of educational material and the way in which it is delivered. This research found that those secondary school rugby players of minority ethnicity, specifically those of Māori ethnicity, are particularly less knowledgeable and have less safe attitudes than the majority Pakeha ethnic group and the heterogeneous 'other' group. This could further add to the vulnerability of this group which has already been shown to have an increased risk of concussion and less access to health care services post TBI.

The work of researcher Dr Elder Hinemoa is relevant here as it involved indigenous research methods to look at Māori perspectives and interpretation of TBI in young people given the cultural belief that the most sacred part of a person is the head (Elder, 2012, 2013). The well recognised models of Māori health which include the whanau (extended family) as a fundamental component (Elder, 2013) of overall wellbeing should be an important consideration when devising TBI education approaches. As the whanau is a crucial factor in maximising recovery for young, Māori, experiencing TBI (Elder, 2013) it is likely to be an important element in increasing the knowledge and encouraging safer attitudes to concussion. A more culturally responsive approach to concussion education might be to offer information to the whanau of rugby players rather than to the player at

an individual or team member level. It is also important to note that Māori are projected to be a growing and youthful population for many years to come and many young people speak Te Reo Māori as their first language (Elder, 2013) so any educational material should be made available in Te Reo Māori and be informed by Māori conceptualisation of TBI.

Elder (2013) found a dominant cultural belief that for Māori TBI does not just cause physical and functional injury, it primarily damages the wairua of a person which is their spirituality or their fundamental sense of the connection between Māori and the universe. TBI also rouses the mindfulness of the head's exceptional status as the most sacred part of the body (Elder, 2013). It is clear that these culturally determined aspects of understanding should be a priority in the development of TBI educational material for Māori. This material needs to be informed and devised by those with relevant cultural knowledge of these conceptualisations. Elder (2012) describes the belief that the head is sacred as a "fruitful springboard for discourse, theorising and practical application of Māori cultural mātauranga (knowledge systems) in both Māori child and adolescent TBI prevention and rehabilitation," (p. 22).

Key areas of concern discussed here deserve more attention in educational strategies, such as the finding that the attitudes to returning to play while suffering concussion symptoms become riskier for important matches such as semi-finals. Informing coaches, parents and others involved in team management about the areas of least knowledge and least safe attitude could be important to increase general awareness and also to maximise opportunities of conveying important information from several sources. Further research is needed to examine where

information which informs concussion knowledge and attitude comes from and also to evaluate the extent to which knowledge and attitude translate to behaviour.

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Appendices

Appendix A: Ethics Approval Letter

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The University of Waikato
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Hamilton 3240,
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Phone 64-7-856 2889
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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

1 July 2014

Karen Pickup
PO Box 251
Thames

Dear Karen

Ethics Approval Application – # 14:37
Title: What Do Secondary School Rugby Players Think About Concussion?

Thank you for your ethics application which has been fully considered and approved by the Psychology Research and Ethics Committee.

Please note that approval is for three years. If this project has not been completed within three years from the date of this letter, you must request reapproval.

If any modifications are required to your application, e.g., nature, content, location, procedures or personnel these will need to be submitted to the Convenor of the Committee.

I wish you success with your research.

Yours sincerely

Professor Michael O'Driscoll
Convenor
Psychology Research and Ethics Committee
School of Psychology
University of Waikato

Appendix B: The Survey

What Do Secondary School Rugby Players Think About Concussion?

Please read the following information.

- This questionnaire (to follow) should take approximately 12-15 minutes to complete. The questions relate to injury and concussion in general and in relation to playing rugby. The goal is to find out what secondary school rugby players think about concussion.
- This research has been approved by the School of Psychology Ethics Committee, University of Waikato.
- All information is anonymous and as such it will not be possible for you to have future access to your questionnaire.
- Parental consent is not required to fill in this questionnaire. However if a parent/caregiver has asked you not to fill in the questionnaire please abide by their wishes.
- Accessing the questionnaire, filling it in and submitting it will be interpreted as your consent to participate in the research.
- Please do not fill in/submit the questionnaire more than once.
- Once you have begun filling in the questionnaire you may stop at any time and withdraw your participation.
- When you have submitted the questionnaire there will no longer be an option to withdraw.
- The information from the questionnaire will form part of a master's thesis titled 'What do secondary school rugby players think about concussion?' by student researcher Karen Pickup. Part of the thesis may be published as an article in an academic journal. Other media, such as newspaper and radio, may be interested in publishing some of the research findings.
- The supervisors of this study are Associate Professor Nicola Starkey and Dr Alice Theadom.
- At the conclusion of research, a summary of details of findings/results will be sent to your school.

If you have any questions or concerns about ethics.

If you have any **questions** or require any further information about this study please contact Karen Pickup (BSocSci. Hons). Email: kjp22@students.waikato.ac.nz

If you have any **concerns about the ethical conduct** of the study please contact Associate Professor John Perrone. Email: jpnz@waikato.ac.nz

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Please continue to the questionnaire.

General Information

What is your date of birth? _____

How old are you? _____

Please tick. Are you [] Male [] Female

Ethnicity

How would you describe your culture of origin? (e.g., European, Tongan, Māori)

_____

Cultural Identity

Which of the following cultures do you MOST identify with?

Please tick one box only.

Māori [] Pakeha [] Other:_____ (specify)

Rugby

How many years have you been playing secondary school rugby?

1 [] 2 [] 3 [] 4 [] 5[] more than 5 []

Which code are you playing this season?

Rugby Union [] Rugby League [] Both []

Have you ever had concussion? Yes [] No []

If 'yes' how many concussions have you had?

1 [] 2 [] 3 [] 4 [] more than 4 []

Do you feel you know enough about concussion? Yes [] No []

Please answer the following questions from your point of view as a rugby player, and in relation to playing rugby and getting injured while playing rugby.

Section 1

Directions: Please read the following statements and circle TRUE or FALSE for each one

1. There is a possible risk of death if a second concussion occurs before the first one has healed.	TRUE	FALSE
2. Running every day does little to improve heart health.	TRUE	FALSE
3. People who have had one concussion are more likely to have another concussion.	TRUE	FALSE
4. Sprigs help players' feet grip the playing surface.	TRUE	FALSE
5. In order to be diagnosed with a concussion, you have to be knocked out.	TRUE	FALSE
6. A concussion can only occur if there is a direct hit to the head.	TRUE	FALSE
7. Being knocked unconscious always causes permanent damage to the brain.	TRUE	FALSE
8. Symptoms of a concussion can last for several weeks.	TRUE	FALSE
9. Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	TRUE	FALSE
10. Weightlifting helps to tone and/or build muscle.	TRUE	FALSE
11. After a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) typically shows visible physical damage (e.g., bruise, blood clot) to the	TRUE	FALSE

brain. TRUE FALSE damage (e.g., bruise, blood clot) to the brain.		
12. If you receive one concussion and you have never had a concussion before, you will become less intelligent.	TRUE	FALSE
13. After 10 days, symptoms of a concussion are usually completely gone.	TRUE	FALSE
14. After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	TRUE	FALSE
15. The colour of your rugby shirt has an effect of on whether you get a concussion or not.	TRUE	FALSE
16. Concussions can sometimes lead to emotional disruptions.	TRUE	FALSE
17. A player who gets knocked out after getting a concussion is experiencing a coma.	TRUE	FALSE
18 There is rarely a risk to long-term health and well-being from multiple concussions.	TRUE	FALSE

Section 2

Directions: Please read the following scenarios and circle TRUE or FALSE for each question that follows the scenarios.

Scenario 1:		
While playing in a game, Player Q and Player X collide with each other and each suffers a concussion. Player Q has never had a concussion in the past. Player X has had 4 concussions in the past.		
1. It is likely that Player Q's concussion will affect his/her long-term health and well-being.	TRUE	FALSE
2. It is likely that Player X's concussion will affect his/her long-term health and well-being.	TRUE	FALSE

Scenario 2:		
Player F suffered a concussion in a game. He/she continued playing in the same game despite the fact that he/she continued to feel the effects of concussion.		
3. Even though Player F is still experiencing the effects of the concussion, his/her performance will be the same as it would be he/she had not suffered a concussion.	TRUE	FALSE

Section 3

Directions: For each question circle the number which best describes how you feel about each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I would continue playing rugby while also having a headache that resulted from a concussion.	1	2	3	4	5
2. I feel that coaches need to be extremely cautious when determining whether a player should return to play.	1	2	3	4	5
3. I feel mouth guards protect teeth from being damaged or knocked out.	1	2	3	4	5
4. I feel that professional players are more skilled at rugby than high school players.	1	2	3	4	5
5. I feel that concussions are less important than other injuries.	1	2	3	4	5
6. I feel that a player has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	1	2	3	4	5
7. I feel that any player that is knocked unconscious should be taken to the emergency room.	1	2	3	4	5

8. I feel that most high-school players will play professionally in the future.	1	2	3	4	5
9. I feel that any player that is knocked unconscious should be taken to a GP.	1	2	3	4	5

Section 4

Directions: For each question read the scenarios and circle the number that best describes your view. (For the questions that ask you what *most players* feel, base your answers on how you think MOST players would feel.)

Scenario 1:

Player R suffers a concussion during a game. Coach A decides to keep Player R out of the game. Player R's team loses the game.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel that Coach A made the right decision to keep Player R out of the game.	1	2	3	4	5
2. Most players would feel that Coach A made the right decision to keep Player R out of the game.	1	2	3	4	5

Scenario 2:

Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semi-final playoff game. Both athletes had persisting symptoms.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. I feel that player M should have returned to play during the first game of the season.	1	2	3	4	5

4. Most players would feel that player M should have returned to play during the first game of the season.	1	2	3	4	5
5. I feel that player O should have returned to play during the semi-final playoff game.	1	2	3	4	5
6. Most players would feel that player O should have returned to play during the semi-final playoff game.	1	2	3	4	5

Scenario 3:					
Player R suffered a concussion. *Player R's team has an athletic trainer on the staff.*					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. I feel that the athletic trainer rather than Player R should make the decision about returning Player R to play.	1	2	3	4	5
8. Most players would feel that the athletic trainer rather than Player R should make the decision about returning Player R to play.	1	2	3	4	5

Scenario 4:					
Player H suffered a concussion and he/she has a *game in two hours.* *He/she is still experiencing symptoms of concussion.* *However, player H knows that if he/she tells his/her* coach *about the symptoms, the coach will keep him out of the game*					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. I feel that Player H should tell his/her coach about the symptoms.	1	2	3	4	5

10. Most players would feel that Player H should tell his/her coach about the symptoms.	1	2	3	4	5

Section 5

Directions: Think about someone who has had a concussion. Tick off the following signs and symptoms that you believe someone may be likely to experience AFTER a concussion.

Allergic Rash		Headache	
Difficulty Speaking		Arthritis	
Sensitivity to Light		Difficulty Remembering	
Panic Attacks		Drowsiness	
Feeling in a "Fog"		Weight Gain	
Feeling Slowed Down		Reduced Breathing Rate	
Excessive Studying		Difficulty Concentrating	
Dizziness		Hair Loss	

Section 6

Directions: Please circle the answer which best describes your view about the following statements.

1. Even after several weeks in a coma, when people wake up most recognize and speak to others right away	True	Mostly true	Mostly false	False
2. After a head injury, people can forget who they are and not recognise others but be perfect in every other way	True	Mostly true	Mostly false	False
3. Sometimes a second blow to the head can help a person remember things that were forgotten	True	Mostly true	Mostly false	False

4. How quickly a person recovers from head injury depends mainly on how hard they work at recovering	True	Mostly true	Mostly false	False
5. A person who has recovered from a head injury is less able to withstand a second blow to the head	True	Mostly true	Mostly false	False
6. Complete recovery from a severe head injury is not possible, no matter how badly the person wants to recover	True	Mostly true	Mostly false	False
7. People who have had one head injury are more likely to have a second one	True	Mostly true	Mostly false	False
8. After a head injury it is usually harder to learn than before the injury	True	Mostly true	Mostly false	False
9. A head injury can cause brain damage even if the person is not knocked out	True	Mostly true	Mostly false	False
10. Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head	True	Mostly true	Mostly false	False
11. Emotional problems after head injury are usually not related to brain damage.	True	Mostly true	Mostly false	False
12. Most people with brain damage look and act disabled.	True	Mostly true	Mostly false	False
13. When people are knocked unconscious, most wake up shortly after with no lasting effects.	True	Mostly true	Mostly false	False
14. People in a coma are usually not aware of what is happening around them.	True	Mostly true	Mostly false	False
15. People with amnesia/loss of memory for events before the injury, usually have trouble learning new things.	True	Mostly true	Mostly false	False

16. Once a recovering person feels 'back to normal' the recovery process is complete.	True	Mostly true	Mostly false	False
17. It is good advice to rest and remain inactive during recovery	True	Mostly true	Mostly false	False

The END

Help and support

If the content of this questionnaire distressed you in any way and you feel you need help and/or support or you would like further information about concussion, you can access support and information at the following places;

Brain Injury Association New Zealand. www.brain-injury.org.nz email: information@brain-injury.org.nz
THINK! The Head Injury Network for Kiwis. www.thinknz.org.nz email: admin@THINKNZ.org.nz
Lifeline Aotearoa. 0800 543 354. 24 hour telephone counselling.

Results

Please indicate if you would like to receive a summary of the results of this study and provide an email address and/or postal address for them to be sent to.

[] Yes, I would like to receive a summary of the results of this study sent to the following email address_____

Postal address._____

[] No, I do not wish to receive a summary of the results of this study.

The email address and/or postal address you provide here will not be linked to your questionnaire. Therefore your questionnaire will remain anonymous.

Appendix C: Māori Language Version of the Survey

Me pānui ngā kōrero kei raro iho

- 12-15 ngā meneti te roa mō te whakautu i ngā pātai. He pā tō ngā pātai ki te whara ō te ūpoko me te mātengatenga ō te kaitākaro hutupōro. Kia kitea hoki te mārama ō ngā ākonga tuarua ki tēnei te mātengatenga.
- Na te komiti o te kura mātai hinengaro, Te Wānanga ō Waikato i tautoko tēnei rangahau.
- Ka noho tapu ngā kōrero. Kore koe āhei kia whiwhi i āu rārangi pātai ā muri ake.
- Ēhara ma ōu maatua koe e āhei ki te whakautu i ngā pātai ēngari i te kore e tautoko mai, ko te hiahia kia waihotia e koe.
- Ma tō whai me te whakakī i ngā rārangi pātai nei me te whakohoki mai, ka tangohia tērā hei tō tohu mo to whakaae ki tēnei rangahau.
- Kia kōtahi noa iho te whakakī i ngā pepa nei
- Ka tāea te puta ahakoa kua timata kee koe ki te whakautu i ngā pātai
- I te wā whakahoki koe i ngā rārangi pātai, kua kore āhei ki te puta me te tango i tō tautoko i te rangahau nei
- Ka tukua ētahi wāhanga ō tēnei rangahau ki tētahi tuhinga roa kō 'What do secondary school rugby players think about concussion?' na tētahi ākonga rangahau nā Karen Pickup. Ētahi wāhanga ō tēnei tuhingaroa ka tāhia ki roto pukapuka akoranga hautaka. Ka wātea atu hoki ki ngā rōpu pāho, nūpepa me ngā reo irirangi.
- Ko Nicola Starkey rāua ko Rata Alice Theadom ngā kaiwhakahaere.
- I te tutukitanga ō tēnei rangahau, ka whakarapopotohia ngā kitenga, hei tuku ki ngā kura

Me he patai **āu**, he **ā**wangawanga rānei mō te taha tiaki mana

mē he pātai āu, i te hiahia ētahi atu māramatanga rānei pā atu ki ā Karen Pickup (BSocSci. Hons). Email: kjp22@students.waikato.ac.nz

Mehemea he āwangawanga ōu mō te taha mana tiaki, me pā atu ki a Associate Professor John Perrone. Email: jpnz@waikato.ac.nz

Haere tonu ki ngā pātai

Ngā pātai whānui

Tō rā whānau _____

Ōu tau _____

Tohu tētahi [] Tāne [] Wāhine

Tukānga iho (Māori, Tonga, Tauiwi)

_____

Tōhua tētahi

Māori Pākehā tētahi atu _____

Hutupōro

E hia ngā tau kua **tākaro** i te kura tuarua?

1[ ] 2[ ] 3[ ] 4[ ] 5[ ] roa atu[ ]

Ko tēhea te rēanga ka tākaro koe i tēnei wāhanga?

Uniana hutup**oro**[ ] Riiki[ ] ngā rua[ ]

Kua raru mātengatenga koe?

1[ ] 2[ ] 3[ ] 4[ ] maha atu[ ]

I te mārama koe mō te mātengatenga

Āe[ ] Kāhore[ ]

Whakautua ngā pātai i te whai ake kia kitea tou mārama ki te whara

Wāhanga Tuatahi

tohutohu: Porowhitahia he pouaka

	Tika	Hē
1. Kei mate koe i te mātengatenga mehemea kāhore i ora muri i te whara tuatahi	Tika	Hē
2. Iti noa te hauora ki te ngākau ahakoa te oma ia rā	Tika	Hē
3. Mehemea kua mātengatenga tuatahi koe, tērā te māma ō te whara anō	Tika	Hē
4. He kaha te pupuri i te kaitākaro mehemea he pine kei ōna hū	Tika	Hē
5. Kia wetewetehia te raru ō te mātengatenga, me moe ohorere koe	Tika	Hē
6. Kia tukia rānō te ūpoko, kātahi kā mātengatenga	Tika	Hē
7. I te moe ohorere koe, he raru ki te roro e kore e ora	Tika	Hē
8. Ka kitea ngā tohu ō te mātengatenga mō ngā wiki i muri mai i taua whara	Tika	Hē
9. Ētahi wā, ka kaha ake te maumahara i muri mai i te mātengatenga tuatahi	Tika	Hē

10. Mā te hiki rino e kaha ake ai ngā uaua	Tika	Hē
11. Muri mai i te mātengatenga me te whakamātautau oranga, e kitea ana te pōketoto me marū ki te roro	Tika	Hē

12. Mehemea kua mātengatenga koe, kāhore anō koe kia whara i mua, ka raru tō mōhio	Tika	Hē
13. Muri i tekau rā ō ngā ra, kua ngāro kē ngā tohu o te mātengatenga	Tika	Hē
14. Muri i te mātengatenga, tēnā pea te wareware ko wai koe me te kore mōhio ki ētahi atu, ēngari e kore e raru ētahi atu huarahi ō tō ao	Tika	Hē
15. Mā te karā ō tō kahu tākaro koe e āwhina kia kore e mātengatenga	Tika	Hē
16. He raru kāre ā roto ka kitea muri i te mātengatenga	Tika	Hē
17. He moe pōrua ki te kaitakaro i muri mai i te mātengatenga	Tika	Hē
18. Kāhore he raru hauora ki te kaitakaro ahakoa e hia ōna mātengatenga	Tika	Hē

Wāhanga Tuarua

Tohutohu: Pānuihia ngā kōrero ka porowhitahia tētahi.

Whakāri Tuatahi:

I te waā tākaro, I tuki a kaitākaro Q rāua ko X. I whara mātengtenga raua ngātahi. Kāhore ano kia whara ā kaitākaro a

Q i mua ēngari e whā ngā whara ō X.

1. Tēnā pea ka whai pānga tenei tuki ki te hauora o te kaitakaro ā Q Tika Hē
2. Tēnā pea ka whai pānga tenei tuki ki te hauora o te kaitakaro ā X Tika Hē

Whakāri tuarua:

I whara te kaitākaro ā F ēngari i tākaro tonu ia āhakoa tōnā rongo i ngā tohu o taua whara.

3. Ahakoa i te rongo tonu F i ngā tohu o te tuki, e kore e rereke tāna tākaro

Tika Hē

Wāhanga Tuatoru

Ngā tohutohu: Mō ia pātai, porowhitahia te nama tautoko koe

	Kaha te whakahē	whakahē	Noho noa	tautoko	Kaha te tautoko
1. Kaitākaro tonu au ahakoa i te anini tōkū ūpoko muri i te whara mātengatenga	1	2	3	4	5
2. Ki ōku whakāro, me tino tūpato ngā kaiārahi kēmu, kia mārama hoki mehemea me tākaro tonu te kaitākaro	1	2	3	4	5
3. Ma ngā kaitiaki waha, e kore e raru ngā niho	1	2	3	4	5
4. E nui atu te pūkenga ō ngā kaitākaro pūmau i tērā ō ngā kaitākaro mai ngā kura tuarua	1	2	3	4	5
5. He iti atu te raru ō te mātengatenga i ērā atu whara	1	2	3	4	5
6. Me hoki ngā kaitākaro ki te kēmu ahakoa ngā tohu ō te whara mātengatenga	1	2	3	4	5
7. I te moe ohorere tētahi kaitākaro, mē kawe ia ki te wāhanga ohorere ō te hohipere	1	2	3	4	5
8. Ka teitei te tūranga ō ngā kaitākaro mai i ngā kura tuarua a tōnā wā	1	2	3	4	5
9. I te whara te kaitākaro, me kawe ia ki te rata hauora	1	2	3	4	5

Wāhanga Tuawha

Ngā tohutohu: Porowhitahia te nama rite ki ōu whakāro. He pātai hoki i te rapu i ōu whakāro mo ētahi atu kaitākaro

Whakāri Tuatahi:

I whara a kaitākaro R i te wā tākaro. I whakaputahia a R i te kēmu. I raru te tīma o R.

	Kaha te whakahē	whakahē	Noho noa	tautoko	Kaha te tautoko
1. Tautoko i te kaiārahi kia puta a R i te kēmu	1	2	3	4	5
2. Ka tautoko te nuinga i te kaiārahi kia puta a R i te kēmu	1	2	3	4	5

Whakāri Tuarua:

I te kēmu tuatahi o te tau, i whara a M. Rite te kaha o te whara o O I te keemu whaiti. I te raru tonu rāua ngātahi i tāua whara.

	Kaha te whakahee	whakahee	Noho noa	Tautoko	Kaha te tautoko
3. Pai kē mehemea i tākaro tonu a M i te kēmu tuatahi	1	2	3	4	5
4. Ka tautoko te nuinga o ngā kaitākaro kia hoki a M ki te kēmu tuatahi	1	2	3	4	5
5. Pai ke mehemea i tākaro tonu a O i te kēmu whaiti	1	2	3	4	5
6. Ka tautoko te nuinga kia hoki a O ki te kēmu whaiti	1	2	3	4	5

Whakāri tuatoru:

I whara mātengatenga a kaitākaro R. He kaitohu whakangūnguu ta te tīma.

	Kaha te whakahē	whakahē	Noho noa	tautoko	Kaha te tautoko
7. Ma te kaiwhakangūngu te whakatau ēhara ma R mehemea ka tākaro tonu ia	1	2	3	4	5
8. Ka tautoko te nuinga kia rite ma te kaiwhakangūngu, ēhara ma R mehemea ka takaro tonu ia	1	2	3	4	5

Whakāri tuawha:

I whara mātengatenga a H, he kēmu tāna i ngā hāora e rua i te heke mai. E rongo tonu ana ia i nga tohu o taua whara ēngari i te mōhio ia mehemea ka kōrero ia ki te kaiārahi, kua kore ia e tukua kia tākaro.

9. Me whakamōhia a H i ana tohu ki te kaiārahi	1	2	3	4	5

10. Ka tautoko te nuinga kia kōrero a H ki te kaiārahi	1	2	3	4	5

Wāhanga tuarima:

Aronga: Whakāro mō tētahi kua whara mātengatenga ka porowhitahia tetahi

kōpukupuku		Anini	
He uaua te kōrero		Mate kaikōiwi	
Mataku ohorere		Te mate wareware	
Noho kohu		Tinana momona	
Ngoikore		Aata tango hā	
Whakatātare		Uaua te whakahihiwa	
Āāmai		Pakira	

Wāhanga tuaono

Aronga: Porowhitahia te whakautu rite ki ōu whākaro

1. Ahakoa e hia ngā wiki i te tūmoe, ka kōrero me te mōhio ki ngā tāngata i te wā oho	Pono	Pono te nuinga	Hē te nuinga	Hē
2. Muri i te whara o te ūpoko, tēra pea ka wareware ko wai koe me te hunga ēngari ka pai rawa koe i ētahi atu huarahi	Pono	Pono te nuinga	Hē te nuinga	Hē
3. Ētahi wā, i te whara te ūpoko mō te wā tuarua, ka pai te maumahara ki ngā mea i warewaretia	Pono	Pono te nuinga	Hē te nuinga	Hē
4. Ma te kaha o te hiki i to hauora, e ora wawe ai muri i te whara	Pono	Pono te nuinga	Hē te nuinga	Hē
5. I te ora te whara ki te ūpoko, he āwangawanga, kei whara mo te wā tuarua kei tino raru.	Pono	Pono te nuinga	Hē te nuinga	Hē
6. E kore e ora pai te hauora i muri mai i te whara kino ki te ūpoko, ahakoa te nui o te hiahia	Pono	Pono te nuinga	Hē te nuinga	Hē
7. I te whara tuatahi o te ūpoko, he māma ake te whara tuatahi	Pono	Pono te nuinga	Hē te nuinga	Hē
8. Muri mai i te whara o te ūpoko, he uaua te hiki i to ahei ki te ako	Pono	Pono te nuinga	Hē te nuinga	Hē
9. He raru ki te roro te hua i te whara te ūpoko ahakoa i moe ohorere te kaitākaro	Pono	Pono te nuinga	Hē te nuinga	Hē
10. Te whara rutu i te kakii, he raru ki te roro pea ahakoa kihai kia u te tuki ki te ūpoko	Pono	Pono te nuinga	Hē te nuinga	Hē

11. Ngā piki heke o ngā kare a roto he raru muri i te whara o te ūpoko, kāhore he pātanga ki te raru te roro	Pono	Pono te nuinga	Hē te nuinga	Hē
12. Te nuinga o te hunga kua raru te roro he rite te kanohi ki te hunga haua	Pono	Pono te nuinga	Hē te nuinga	Hē
13. Mo te nuinga i moe ohorere, kāhore he raru ki te hauora i te ohonga mai	Pono	Pono te nuinga	Hē te nuinga	Hē
14. Mo te hunga i te moe whara, kahore i te mārama ki tona ao	Pono	Pono te nuinga	Hē te nuinga	Hē
15. Te hūnga i te raru te maumahara i mua i te whara ka raru te āhei ki te ako mea hou	Pono	Pono te nuinga	Hē te nuinga	Hē
16. I te wā e ora ake ano ki te oranga i mua i te whara, ko tērā te tau mai o te hauora	Pono	Pono te nuinga	Hē te nuinga	Hē
17. Pai te whakatā me te noho puku i te wā e hoki mai te hauora	Pono	Pono te nuinga	Hē te nuinga	Hē

Te Mutunga

Aawhina me te tautoko

Mehemea he wāhanga o tēnei rārangi pātai i te whakahemanawa i a koe, i te hiahia kōrero rānei koe **mo** te mātengatenga. Ka taea e koe e aro atu ki te rapu āwhina me te tautoko;

Brain Injury Association New Zealand. www.brain-injury.org.nz email: information@brain-injury.org.nz
THINK! The Head Injury Network For Kiwis. www.thinknz.org.nz email: admin@THINKNZ.org.nz
Lifeline Aotearoa. 0800 543 354. 24 hour telephone counselling.

Results

Mehemea I te hiahia koe kia tukua atu he whakarapopototanga o tēnei kohinga kōrero mā īmera, mā reta rānei ka taea te whakarite.

[ ] Ae i te hiahia ahau kia tukua mai ki taku īmera _____

kāinga noho _____

[ ] Kāhore au i te hiahia ki nga whakarapopototanga

E kore to īmera, to kāinga noho rānei e honohia ki to rārangi pātai, nō reira ka noho tapu au tuhinga katoa.

Appendix D: The RoCKAS-ST Scoring Key

Scoring Key for RoCKAS-ST

Section											
1			2			3			4		
Item	Correct Response	Index	Item	Correct Response	Index	Item	Safer Response	Index	Item	Safer response	Index
1	True	CKI	1	False	CKI	1	SD/D	CAI	1	SA/A	CAI
2	False	NI	2	True	CKI	2	SA/A	CAI	2	SA/A	CAI
3	True	CKI	3	False	CKI	3	SA/A	NI	3	SD/D	CAI
4	True	VS				4	SA/A	NI	4	SD/D	CAI
5	False	CKI				5	SD/D	CAI	5	SD/D	CAI
6	False	CKI				6	SD/D	CAI	6	SD/D	CAI
7	False	CKI				7	SA/A	CAI	7	SA/A	CAI
8	True	CKI				8	SD/D	NI	8	SA/A	CAI
9	False	CKI							9	SA/A	CAI
10	True	VS							10	SA/A	CAI
11	False	CKI									
12	False	CKI									
13	True	CKI									
14	False	CKI									
15	False	VS									
16	True	CKI									
17	True	CKI									
18	False	CKI									

CKI = Concussion Knowledge Index; CAI = Concussion Attitude Index; VS= Validity Scale; NI = no index- item not appear on any index; SD/D = strongly disagree/disagree; SA/A = strongly agree/agree.

Appendix: E: The CKI Symptom Answer Key

Actual post-concussive symptoms	Not post-concussive symptoms
Sensitivity to light	Allergic rash
Feeling in a fog	Difficulty speaking
Feeling slowed down	Panic attacks
Dizziness	Excessive studying
Headache	Arthritis
Difficulty remembering	Weight gain
Drowsiness	Reduced breathing rate
Difficulty concentrating	Hair loss

Appendix F: The Misconception Index Answer Key

MI Item	Correct Answer
1. Even after several weeks in a coma, when people wake up most recognize and speak to others right away	False
2. After a head injury, people can forget who they are and not recognise others but be perfect in every other way	False
3. Sometimes a second blow to the head can help a person remember things that were forgotten	False
4. How quickly a person recovers from head injury depends mainly on how hard they work at recovering	False
5. A person who has recovered from a head injury is less able to withstand a second blow to the head	True
6. Complete recovery from a severe head injury is not possible, no matter how badly the person wants to recover	True
7. People who have had one head injury are more likely to have a second one	True
8. After a head injury it is usually harder to learn than before the injury	True
9. A head injury can cause brain damage even if the person is not knocked out	True
10. Whiplash injuries to the neck can cause brain damage even if there is no direct blow to the head	True
11. Emotional problems after head injury are usually not related to brain damage.	False
12. Most people with brain damage look and act disabled.	False
13. When people are knocked unconscious, most wake up shortly after with no lasting effects.	False
14. People in a coma are usually not aware of what is happening around them.	True
15. People with amnesia/loss of memory for events before the injury, usually have trouble learning new things.	True
16. Once a recovering person feels ‘back to normal’ the recovery process is complete.	False
17. It is good advice to rest and remain inactive during recovery	False