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CONCUSSION KNOWLEDGE AMONG SOUTH AFRICAN RUGBY PLAYERS

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CONCUSSION KNOWLEDGE AMONG SOUTH AFRICAN RUGBY PLAYERS

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A mini-script submitted in partial fulfilment of the requirements of the ***Master of Science in Physiotherapy, with Specialisation in Clinical Sport Physiotherapy*** in the Faculty of Health Sciences, University of the Free State.

July 2016

DECLARATION

I, Carel Thomas Viljoen, certify that the script hereby submitted by me for the M.Sc. (Physiotherapy) with *Specialisation in Clinical Sport Physiotherapy,* degree at the University of the Free State is my independent effort and had not previously been submitted for a degree at another university/ faculty. I furthermore waive copyright of the script in favour of the University of the Free State.

_____

Your name

July 2016

I, Corlia Brandt, approve submission of this mini-script as partial fulfilment for the M.Sc. (Physiotherapy) with *Specialisation in Clinical Sport Physiotherapy*, degree at the University of the Free State. I further declare that this mini-script has not been submitted as a whole or partially for examination before.

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Corlia Brandt (Study leader)

July 2016

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LIST OF ABBREVIATIONS AND ACRONYMS

ARF	Australian Rules Football
BBRU	Blue Bulls Rugby Union
BMI	Body mass index
CAI	Concussion Attitudes Index
CDC	Centre for Disease Control
CKI	Concussion Knowledge Index
CME	Continuing medical education
CT	computed tomography
CTE	Chronic traumatic encephalopathy
FRU	Falcons Rugby Union
GDE	Gauteng Department of Education
GLRU	Gauteng Lions Rugby Union
GSC	Graded symptom checklist
IOC	International Olympic Committee
JAHS	Junior amateur high school
MI	Motivational Interviewing
MRI	Magnetic resonance imaging
MTBI	Mild traumatic brain injury
NATA	National Athletic Trainer's Association
NFL	National Football League
PTH	Post-traumatic headache
RoCKAS-ST	Rosenbaum Concussion Knowledge and Attitudes Survey - Student Version
RTP	Return to play
RWC	Rugby World Cup
SAC	Senior Amateur Club
SARU	South African Rugby Union
SCAT-3	Sports Concussion Assessment Tool 3
SIS	Second impact syndrome
SLICE	Sports Legacy Institute Community Educators
UFS	University of the Free State
VS	Validity scale
WAD	Whiplash associated disorders

ABSTRACT

Background: Concussion is one the most frequently reported injuries among rugby players. Potential dangerous long term side-effects such as neurological deficits and chronic traumatic encephalopathy (CTE), explain why concussion is currently an extensively debated topic in the media. The largest part of South Africa's rugby playing population consists of amateur players. Anecdotal evidence suggest that only a very limited proportion of amateur clubs and schools offer medical assistance at matches or practices, generally due to a lack of funding. *BokSmart* currently leans towards educating coaches and referees to recognize concussion signs and symptoms and to remove concussed players from the field. However, in a country where field side medical assistance is scarce, the players themselves can play a pivotal role to report possible concussions to their coach or the referee. Currently, no rugby safety management programme is focussing on concussion education among South African rugby players. Further research on concussion knowledge among rugby players are warranted to generate benchmark data needed to inform development and motivate implementation of educational programmes among rugby players, as an addition to the current *BokSmart* programme.

Aims: To evaluate the knowledge on concussion and attitudes/behaviours regarding concussion and return to play (RTP) among South African amateur high school and club rugby players.

Methods: A descriptive, cross-sectional study design was used to achieve the aims. The participants (n = 294) were divided into two groups namely; junior amateur high school (JAHS) (n = 216) and senior amateur club (SAC) (n = 78) rugby players. All participants completed the modified Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) in order to evaluate their concussion knowledge and attitudes/behaviours regarding concussion and RTP. Descriptive statistics were used to summarise continuous data with means and standard deviations or medians and percentiles as appropriate. Frequencies and percentages were calculated for categorical data while significance was set at $p < 0.05$ for comparative analyses.

Results: The Concussion Knowledge Index (CKI) mean correct answered questions in the JAHS group was 10.46 ± 2.36 (range 3 – 15) of a maximum score of 17 points. Participants of the JAHS on average identified 62.4% of the CKI questions correctly. The CKI mean correct answered questions in the SAC group was 10.17 ± 2.35 (range 4 – 14) of a maximum score of 17 points. Participants of the SAC group on average identified 60.2% of the CKI questions correctly. On average the JAHS participants identified 66.3% of concussion symptoms correctly, while the SAC participants only identified 62.7% correctly. The Concussion Attitudes Index (CAI) mean correct answered questions in the JAHS group was 56.49 ± 8.81 (range 36 – 75) of a maximum score of 90 points. Participants of the JAHS group had a mean safe response of 65.6% when answering the attitude/behaviour regarding concussion and RTP questions. The CAI mean for correct answered questions in the SAC group was 55.88 ± 11.42 (range 20 – 75) of a maximum score of 90 points. Participants of the SAC group had a mean safe response of 67% when answering the attitude/behaviour regarding concussion questions. No statistical significance were found between the mean concussion knowledge scores ($p > 0.37$) of the JAHS and SAC participants. A p-value of $p > 0.98$ was noted, also showing no statistical significance between the JAHS and SAC participants' mean concussion attitude scores.

Conclusion: It was concluded that both junior and senior South African amateur rugby players had insufficient knowledge on concussion. The participants' lack of concussion knowledge were further emphasised during the poor concussion symptom identification. Both groups showed unsafe attitudes/behaviours towards concussion and RTP.

KEYWORDS

Concussion, concussion knowledge, concussion rugby union, concussion attitudes, concussion behaviours, rugby union, head injuries, sports injuries, sports-related concussion, return to play.

CHAPTER 1
INTRODUCTION

1.1 SCOPE OF RESEARCH

Rugby Union (hereafter rugby) is a global sport and forms part of the top three most popular contact sports played worldwide (Freitag *et al*., 2015a:1). The sport's popularity is particularly large in South Africa with a total number of 418 509 rugby players in the country during 2014, representing more than 17% of the global rugby playing population (World Rugby, 2016a).

Rugby participation exposes an individual to a high risk for injury due to the fact that a player may legitimately exert extreme force onto an opponent to gain possession of the ball (Carter, 2015:1). In comparison to other collision team sports like ice hockey, rugby league, National Football League (NFL) and Australian Rules Football (ARF), rugby has one of the highest incidences of reported match injuries (Thompson, 2014:8). During the Rugby World Cup (RWC) in 2011, an injury surveillance study was done on elite professional rugby players. It concluded that the most common match injury sustained by backline rugby players were shoulder injuries while forward rugby players most commonly sustained head and face injuries (Fuller *et al*., 2013:6). Haseler *et al*. (2010:1097) studied amateur youth rugby players and showed similar results where the head, neck and shoulders were the most frequently injured anatomical sites (Haseler *et al*., 2010:1097). A more recent review done in 2015 on the epidemiology of rugby injuries supports this view that head injuries, including concussions, are the most frequent reported injury in professional rugby (Kaux *et al*., 2015:22). Concussion in rugby is most commonly noted at community/amateur level with a rate of 2.08 per 1000 player match hours. This is followed by schoolboy level and elite level with respective rates of 0.62 and 0.40 per 1000 player match hours (Gardner *et al*., 2014:1726).

Concussion is a subcategory of head injuries which is sustained when a physical blow to the head or rest of the body expose the brain to acceleration and deceleration forces inside the skull (Echemendia, 2012:208). It is a subset of mild traumatic brain injury (MTBI) and defined as a "traumatically induced transient disturbance of brain function which involves a complex pathophysiological process" (Harmon *et al*., 2013:15). "Concussion is generally self-limited and at the less severe end of the brain injury spectrum" (Harmon *et al*., 2013:15). However, a concussion should still be treated with

caution since a history of previous concussion is a pronounced risk factor predisposing an athlete to sustain a repeated concussion, which may increase the severity thereof on the brain injury spectrum.

Acute effects following a concussion include a variety of cognitive and neurological symptoms which are self-limiting and can last for a few days (Edwards & Bodle, 2014:129). Potentially dangerous long term side-effects such as neurological deficits and chronic traumatic encephalopathy (CTE), explain why concussion is currently an extensively debated topic in the media (Raftery, 2014:79). CTE is a neurodegenerative process linked to the early onset of cognitive decline and psychiatric disturbances as a result of repeated concussions (Edwards & Bodle, 2014:130). The continuous media reports of possible long-term neurological deficits associated with participation in contact sports can discourage parents to expose their children to rugby, resulting in the children missing out on exercise-related health benefits and decreasing the active rugby playing population (Raftery, 2014:79). The debate surrounding contact sports and concussion is not isolated to rugby, as seen on the class-action lawsuit between the NFL and over 5000 former NFL players who suffer from chronic neurocognitive illnesses or who are currently healthy but fear the possible development of symptoms in the future (Martin, 2016). The former NFL players accused the league of failing to educate them on the possible dangers of participating in the sport, with specific reference to concussion-related injuries and the long term effects thereof (Martin, 2016). This highlights the need to ensure that not only medical professionals, referees and coaches should be educated on sports related concussions, but also the athletes participating in various contact sports.

The largest part of South Africa's rugby playing population consists of amateur players. Anecdotal evidence suggest that only a very limited proportion of amateur clubs and schools offer medical assistance next to the rugby field, and that the assistance is mostly limited to matches. The majority of the amateur rugby playing population have no medical assistance at matches or practices, generally due to a lack of funding (BokSmart, 2012). Therefore, the focus of *BokSmart* programme currently leans towards educating coaches and referees to recognize concussion signs and symptoms and to remove concussed players from the field (BokSmart, 2012). However, players are often most familiar with their teammates and the first ones to notice any signs or symptoms among their teammates. Therefore, in a country where field side medical assistance is scarce, the players themselves can play a pivotal role to report possible concussions to their coach or the referee. To ensure that players keep a vigilant eye out for their teammates, it is

vital that players understand the dangers of playing while concussed. In addition, concussed players need to understand the importance of being cleared by a medical doctor before returning to full participation in rugby to avoid another concussion for which they are predisposed to, as well as more serious head injuries such as secondary impact syndrome (SIS) and CTE (Edwards & Bodle, 2014:129).

Currently, no rugby safety management programme focus on concussion education among South African rugby players, despite watershed events such as the NFL lawsuit (Martin, 2016). In order to develop and implement concussion educational programmes for rugby players, their knowledge on concussion first need to be determined. Only a single study to date has investigated the concussion knowledge and return to play (RTP) attitudes among South African rugby players (Walker, 2015:51). RTP attitudes in the context of this study, referred to how players will react in certain scenarios relating to concussion and RTP, focussing on their health behaviours. It was concluded that the players had less than optimal knowledge and will return to play before fully recovered from a concussion (Walker, 2015:50). Therefore, further research on concussion knowledge among rugby players are warranted to generate the benchmark data needed to inform development and motivate implementation of educational programmes among rugby players as an addition to the current *BokSmart* programme.

1.2 AIMS AND OBJECTIVES OF THE STUDY

This study aimed to evaluate the knowledge on concussion and attitudes/behaviours towards return to play of South African amateur high school and club rugby players in order to motivate and inform future intervention for player education. Attitudes specifically refer to the decision-making and behaviour of participants regarding concussion and RTP. Based on anecdotal experience and the study by Walker (2015:54), it was hypothesised that both amateur and schoolboy rugby players had insufficient knowledge about concussions.

1.2.1. Objectives

1.2.1.1 To determine the knowledge on concussion among amateur South African rugby players.

1.2.1.2 To determine the attitude/behaviour regarding concussion injuries and RTP among amateur South African rugby players.

1.2.1.3 To compare junior amateur high school (JAHS) and senior amateur club (SAC) rugby players' knowledge and attitude/behaviour regarding concussion injuries and RTP

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1.3. STUDY SYNTHESIS

This dissertation consists of six chapters. Chapter one gives an introduction to the study and provides the researcher with an overview of what is to follow. This is followed by a literature review in Chapter two. The literature review starts broadly on rugby as a sport and rugby related injuries. It is later narrowed down to specifically concussion in rugby and the need for further concussion education among players. Chapter three discuss the research methodology used in the study followed by Chapter four which gives a full report of the results of answers obtained using the modified Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) questionnaire. A discussion of the results and relevant themes are provided in Chapter five with concluding remarks made in Chapter six. A full list of references and appendices are provided at the end of this dissertation.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

In this literature review the most relevant studies are discussed regarding concussion in rugby. An overview of rugby as a sport is given and the nature of injuries sustained during participation. The epidemiology of concussion in rugby specifically are looked at and how it influences the game. Further factors regarding concussion risks, effects, management, prevention and outcome measures are discussed. This builds up to the main focus of concussion knowledge among players and the effect of education.

The initial literature search was done over a period of one month in January 2015. This search was updated with a further search over a three month period from July 2015 to end of October 2015. The last updated search was in March 2016. Ten different databases have been used in the search and they were accessed through the University of the Free State. These databases included: Medline, Cinahl, PEDro, Cochrane library, Pubmed, Africa Wide, Sportsdiscuss, Google Scholar, Health source (consumer edition) and Health source (nursing/academic edition). The keywords used during the searches included: concussion knowledge, concussion rugby union, rugby union, concussion, sports injuries, head injuries, and sports-related concussion.

2.2 RUGBY UNION

Rugby Union (hereafter rugby) is a sport played globally and forms part of the top three most popular contact sports played worldwide (Freitag *et al.*, 2015a:1). Rugby's popularity is continuously growing as seen in 2014 where the total number of players grew from 6.66 million to 7.23 million across 102 countries (World Rugby, 2016a). The sport's popularity is particularly large in South Africa with a total number of 418 509 rugby players in the country, forming more than 17% of the global rugby playing population (World Rugby, 2016a). The World Rugby Organization further helps promote the sport through their *Get Into Rugby* programme that introduced 488 000 new children to rugby in 2014 (World Rugby, 2016a). This rapid growth of rugby's popularity was noted over the years by the International Olympic Committee (IOC) and the decision was made to

include rugby's seven-a-side version in the 2016 Olympic Games to be held in Rio, Brazil (World Rugby, 2016b).

The origin of the game dates back to 1823 when a schoolboy, William Web Ellis, picked up a football during a match and started running with the ball. Rugby has since developed into a professional sport guided by laws to allow participation in a competitive, enjoyable and controlled environment (World Rugby, 2016c). The object of rugby is to score more points than the opposition team through carrying, kicking, passing and grounding the ball behind the opposition try line (World Rugby, 2016c). Rugby is a physically demanding sport and classified as a collision team sport (Patricios & Kemp, 2014:77). There are various forms of the game, however the fifteen-a-side and seven-a-side (more commonly known as 7's) versions are the most popular played worldwide.

Men, boys, girls and women of all different body compositions can participate in rugby (Patricios & Kemp, 2014:77). Therefore the game is open to all and this makes rugby promotion easy among the youth as means of addressing childhood obesity (Freitag *et al.*, 2015a:1). However, even though there is a direct relation between inactivity and childhood obesity, no study has yet shown health benefits of specifically rugby participation (Freitag *et al.*, 2015a:1).

2.3 EPIDEMIOLOGY OF RUGBY INJURIES

During 2008, Kaplan *et al.* (2008:91) performed a review study on rugby injuries using the available literature at that stage. They emphasised the difficulty of using a meta-analysis due to lack of uniformity of injury definition and methodology used in data collection. This lack in uniformity of injury definitions in particular, resulted in only four studies being included in this review. Through their review a conclusion was made that injuries more often occur during open play than in set pieces. It was further noted that injuries differ between playing positions however, these authors could not provide a full appreciation of the injury difference characteristics (Kaplan *et al*., 2008:91). Injuries rarely occurred during set pieces and more often during uncontrolled play. This observation was attributed to the increased awareness of spinal injury risk during set pieces which resulted in referees taking more control over set pieces to ensure player safety (Kaplan *et al*., 2008:91). The majority of injuries sustained were musculotendinous- and ligamentous injuries of the upper and lower limbs. However, reference were made to the high number of concussions, head and neck injuries

recorded (Kaplan *et al*., 2008:91). It is difficult to draw significant conclusions about injury epidemiology from that review due to the small number of studies included. However this review by Kaplan *et al.* (2008) created important awareness on the growing number of injuries observed in rugby.

Recently, Thompson (2014:53) conducted an epidemiological study on injuries sustained during the 2012 Super 15 rugby tournament. The 125 participants were elite-level senior rugby players with a mean age of 25 years old. A higher injury incidence was noted during matches compared to training sessions. Thompson (2014:62) concluded that the most commonly injured anatomical site during matches was the shoulder/clavicle with 16.5 per 1000 player match hours. Also, emphasis was placed on the high incidence of head/face (including concussion) injuries showing 11.2 per 1000 player match hours (Thompson, 2014:62). Fuller *et al.* (2013:6) investigated a similar population group and studied 615 elite rugby players that participated in the 2011 Rugby World Cup. Their results were similar to Thompson (2014:53) stating that the most common match-injury sustained by backline players were shoulder injuries, while forward players most commonly sustained head and face injuries (Fuller *et al*., 2013:6). A recent review on epidemiology of rugby injuries reported that elite professional rugby players most commonly sustained injuries to the head, including concussion (Kaux *et al*., 2015:22). In contrast to Thompson (2014), Kaux *et al*. (2015:22) states that the knee, thigh and ankle are more commonly injured than the shoulder.

Haseler *et al*. (2010:1097) studied a different population group namely amateur youth rugby players. They included 210 youth rugby players of the age groups under nine to under 17 years old. Even though the sample's age and level of participation differs from those of Thompson (2014:54) and Fuller *et al*. (2013:2), similar results were obtained. As with senior elite rugby players, the head, neck and shoulder also showed to be the most frequently injured anatomical site (Haseler *et al*., 2010:1097). Haseler *et al*. (2010:2097) further stated that half of all head injuries recorded were concussions. A similar conclusion was made by Freitag *et al*. (2015a:8) when they performed a systematic review on rugby injuries sustained by children and adolescents under the age of 21 years old. They further drew attention to the high incidence of concussion and described how concussion is part of the most common injury categories (Freitag *et al*., 2015a:8). Roberts *et al*. (2014:2) also studied rugby injuries among amateur players. Although they specifically looked at senior amateur club rugby players. Their findings are in line with studies on youth amateur and senior elite rugby players. The top two

anatomical sites requiring medical attention were the head and neck, with the head (including concussions) at the top of the list (Roberts *et al*., 2014:3).

Evaluating the anatomical regions where rugby injuries commonly occur, a clear pattern seem to emerge from literature, irrespective the rugby players' age group or level of participation. Specifically head injuries (including concussion) are of concern with a high incidence reported in epidemiological studies on rugby injuries.

2.4 CONCUSSION

Concussion is a subcategory of head injuries and defined as: "a traumatically induced transient disturbance of brain function and involves a complex pathophysiological process". "Concussion is a subset of mild traumatic brain injury (MTBI) which is generally self-limited and at the less severe end of the brain injury spectrum" (Harmon *et al.,* 2013:15). McCrory *et al*. (2013:554) agrees with this definition and further accents that even though concussion and MTBI are used interchangeably in some literature, concussion remains only a subset of MTBI. A concussion is sustained when the brain is exposed to acceleration and deceleration forces inside the skull, due to a physical blow to the head or rest of the body (Echemendia, 2012:208). This "shaking" of the brain inside the skull will cause clinical symptoms, however this will not always result in a pathological injury of the brain (McCrory *et al*., 2013:554). The concussion mechanism of injury is similar to a whiplash injury. Symptoms following a whiplash can mimic concussion symptoms and is defined as a whiplash associated disorder (WAD) (Treleaven *et al*., 2003:36). The role of a physiotherapist is particular important during this phase as to provide treatment for the cervical spine in order to address the WAD. A WAD injury leads to decreased active ROM and poor cervical proprioception, therefore the need to regain mobility and proprioception before return to play (RTP) (Loudon *et al*., 1997:867).

2.4.1 Epidemiology of concussion in rugby

Kemp *et al*. (2008:228) used a prospective cohort study to follow 757 professional rugby players from 2002 to 2006 with the aim of reporting on head injury epidemiology. Of all head injuries recorded, 62% were concussions with an incidence rate of 4.1 per 1000 player match hours. The concussion incidence rate in trainings was significantly lower at 0.02 per 1000 player training hours, confirming the higher risk for injury during matches. They described how concussions were most often sustained during open play,

specifically the tackling event and collisions (Kemp *et al*., 2008:229). Fuller *et al*. (2014:3) supported these results and found the concussion incidence among elite international players to be between 3.3 and 5.4 per 1000 player match hours. Fraas *et al*. (2014:137) also studied the concussion incidence among elite rugby players; however, they focussed on self-reported rates of concussion. Although a large percentage (44.9%) of self-reported concussion rates were noted, these results could not be verified due to the retrospective nature of the study and therefore negatively impacts the validity of the findings (Fraas *et al*., 2014:139).

A recent systematic review on concussion in rugby not only assessed the elite senior rugby player population, but further included junior amateur (high school) and senior amateur (community) rugby players (Gardner *et al*., 2014:1723). Their results showed that concussion in rugby is most commonly reported at community/amateur level with a rate of 2.08 per 1000 player match hours. This is followed by schoolboy and elite level with respective rates of 0.62 and 0.40 per 1000 player match hours (Gardner *et al*., 2014:1726). The incidence of concussion at elite level is notably lower compared to the results of Kemp *et al*. (2008:229) and Fuller *et al*., (2014:2). This variation can possibly be attributed to variation in injury definition among the different authors. In an earlier study done by Shuttleworth-Edwards *et al*. (2008:403) on South African rugby players between 2002 and 2006, contrasting results were found to Gardner *et al*. (2014:1726). Shuttleworth-Edwards *et al.* (2008:406) stated that the concussion incidence at adult level was higher ranging between 3% and 23%, while school level players had an incidence of between 4% and 14%. It is important to note that their adult group also included provincial level players where professional medical teams were involved in assisting with concussion identification and management. An analysis of this specific group showed that the high incidence of reported concussions (23%) only occurred at the provincial level. At University and club level, low incidences of 3% and 5% respectively were documented (Shuttleworth-Edwards *et al*., 2008:408). This may possibly be attributed to the lack of medical attention at the amateur levels resulting in fewer diagnosed and consequently reported concussions. The same principle applied to their school level rugby group where the private schools showed a higher incidence of reported concussion than the government schools. At private schools there is a milieu of more individual attention leading to increased reported concussions (Shuttleworth-Edwards *et al.,* 2008:407). The author further also stated that the specific study was not designed to specifically record concussion incidence (Shuttleworth-Edwards *et al*., 2008:408).

An injury surveillance study done on 5412 South African youth rugby players between 2011 and 2013 reported a concussion incidence of 6.3 per 1000 player match hours (Mc Fie *et al*., 2014:120). This incidence rate has shown to be higher than any of the senior amateur or elite rugby player populations. Similarly, Shirazi *et al*. (2015:39) also studied rugby injuries among a youth population. They used the injury reporting database of Canadian hospitals and reported 6200 rugby-related injuries between 1990 and 2014. Of these injuries 48.9% were brain injuries with concussion contributing to the majority (70.7%) of brain injuries (Shirazi *et al*., 2015:39). These results further supported Mc Fie *et al*. (2014:120) and emphasised the high risk for sustaining a concussion among youth rugby players.

2.4.2 Post-concussion effects

One of the concerns regarding concussion injuries relates to the acute effects following a concussion, which include a variety of cognitive and neurological symptoms which are self-limiting, but can last for a few days (Edwards & Bodle, 2014:129). Headache is one of the most common complaints following a concussion (Seifart, 2013:732). It is also the symptom that often takes the longest time period to resolve (Seifart, 2013:732). Cognitive impairment was also noted in the presence of a post-traumatic headache (PTH) (Seifart, 2013:732). Baker and Cinelli (2014:6) reported decreased dynamic balance control during functional movements and poor decision making abilities for up to 30 days post-concussion, which will potentially expose the athlete to re-injury. Moore *et al*. (2014:38) further stated that long-term negative effects on visual processing are also seen following concussion in young adults. Specifically in paediatric athletes, vestibular dysfunction with symptoms of dizziness or imbalance was recorded following a sports-related concussion (Zhou & Brodsky, 2015:1138). Second impact syndrome (SIS), which can be fatal, occurs when repeated concussions are sustained without enough rest for the initial concussion to resolve (Edwards & Bodle, 2014:129). As the cervical spine also takes strain during a concussion and often mimics concussion symptoms (Oliver & Craton, 2013:331), the medical team should thoroughly evaluate a player to ensure not missing an underlying concussion. Here a physiotherapist plays a major role in eliminating neuro-musculoskeletal symptoms that can mimic a concussion.

It is understandable that concussion is currently an extensively debated topic in the media more due to the potential danger of long-term neurological deficits including chronic traumatic encephalopathy (CTE) (Raftery, 2014:79). CTE is a neurodegenerative process linked to early onset of cognitive decline and psychiatric disturbances as a result

of repeated concussions (Edwards & Bodle, 2014:130). CTE has not only been observed in athletes with a long career in contact sports, but also in high school athletes suggesting that youth potentially also presents as an at-risk population (Carman *et al*, 2015:233). Although cases of CTE have been identified in rugby players, the prevalence and incidence are still unknown among amateur and professional athletes (Carman *et al*., 2015:233). Emphasis must be placed on the fact that it is still unknown if there is link between concussions and long-term neurological deficits (Raftery, 2014:79).

It is therefore clear, that improved education and identification of risk factors regarding concussion, and the management thereof, may play an important role in the prevention of neuro-musculoskeletal as well as neurological consequences.

2.4.3 Concussion risk factors

The highest risk for sustaining a concussion in sport is when the athlete has a history of a previous concussion (Abrahams *et al*., 2014:7). An evidence-based review showed that lower levels of participation, unconditioned players, lower body mass index (BMI) and fatigue, further increase a player's risk for sustaining concussion (Abrahams et al., 2014:6). Conder & Conder (2015:90) agreed on an increased risk for injury if the player has a history of concussion and plays at lower levels of participation. They also added that younger age specifically increased the risk for concussion (Conder & Conder, 2015:90). This study however looked at sport in general and did not specifically focus on rugby alone.

2.4.4 Concussion prevention

Proper management and investigation of risk factors are important to help prevent concussion injuries. McIntosh *et al.* (2009:310) performed the first randomised controlled trial on padded headgear as an injury prevention tool in rugby. Only amateur youth players were tested due to the higher rate of concussion noted in this specific population. McIntosh *et al*. (2009:312) concluded that padded headgear do not have an ability to reduce the rate of head injuries or concussions. Benson *et al*. (2013:5) supported these results and stated that the use of headgear for injury prevention in rugby is still inconclusive. The review further emphasised that no other protective equipment namely mouth guards, face shields or helmets have shown conclusive evidence in preventing concussion in contact sports (Benson *et al*., 2013:5). Neck muscle strengthening has been proposed as means of concussion prevention in contact sports, however a review

of literature described the lack of conclusive scientific evidence to support this notion (Caswell *et al*., 2014:26). A similar view is held by Benson *et al*. (2013:5) who further described how there is no evidence to support the link between increased neck strength and decreased risk for sustaining a concussion.

Specifically in rugby, positive results regarding prevention of concussion have been shown by implementing an annual awareness programme among referees and coaches. *RugbySmart* is such an awareness program introduced in New Zealand which was made compulsory for all coaches and referees (Gianotti & Hume, 2007:1). A marked reduction in personal injury claims and associated costs arising from concussion/brain injuries were noted since the introduction of the programme in 2001 (Gianotti & Hume, 2007:5). Due to the effectiveness of the New Zealand *RugbySmart* programme, the South African Rugby Union (SARU) introduced their own programme in 2009 called *BokSmart* (Brown, 2014:17). *BokSmart* has many similarities to the *RugbySmart* programme as it was adapted and developed based on the New Zealand programme with a primary aim of preventing catastrophic injuries through the education of referees and coaches (Brown, 2014:18). Even though the programmes have similarities, the two nations differ in that Africa is a developing country working with coaches, referees and players from a different socio-economic background (Brown, 2014:111) which had to be taken into consideration during the development of the programme. Four years after its implementation, an evaluation of *BokSmart* showed a significant decrease in head/neck injuries, specifically among junior rugby players (Brown, 2014:116). Senior players have shown to be unaffected by the programme which can be due to junior players that are more easily influenced by coaches or the 5:1 ratio of junior to senior players in the sample (Brown, 2014:174). Other countries such as Australia, England, Ireland and Scotland have also implemented their own programs, however only *RugbySmart* of New Zealand and *BokSmart* of South Africa have proven to reduce catastrophic injuries (Freitag *et al*., 2015b:2).

2.4.5 Concussion management

In the 2014 National Athletic Trainer's Association (NATA) position statement on concussion management, a comprehensive approach was described (Broglio *et al*., 2014). In this statement Broglio *et al*. (2014:251) describes the importance of baseline testing to be done pre-season. Baseline testing provides the clinician with data on the player's brain function while not injured and therefore aid the management process and timing of RTP. Concussion management starts on-field by effectively identifying a

concussion. A player who is suspected of sustaining a concussion should be immediately removed from the field in order to do a systematic evaluation (Broglio *et al*., 2014:253). Various side-line assessment tools are available for concussion evaluation. Guskiewicz & Teel (2015:157) states that a graded symptom checklist (GSC) has the highest specificity and sensitivity for diagnosing a concussion, whereas the commonly used Sports Concussion Assessment Tool 3 (SCAT-3) had no psychometric data available. However the certain components of the SCAT-3 have been shown to have high clinical value in diagnosing a concussion (Guskiewicz & Teel, 2015:157).

Broglio *et al.* (2014:253) further describes that a concussed player with declining mental status or loss of consciousness for more than a minute, or signs and symptoms of a more severe injury, needs to be taken to a medical facility. Chermann *et al.* (2014:2) who developed a successful concussion management protocol for rugby which included computed tomography (CT) scan or a magnetic resonance imaging (MRI) of the brain to exclude any further brain damage. However these investigations are usually only requested by the attending physician if further brain damage is expected. Other special investigations that may be helpful in specifically diagnosing concussion are functional MRI, magnetic resonance spectroscopy and serum biomarkers, yet these investigations have not been validated to be used exclusively in diagnosing concussion injuries (Broglio *et al*., 2014:253).

A concussed player should be assessed daily by a clinician and advised to rest from all physical activity and to limit cognitive activity (Broglio *et al*., 2014:253). It is recommended that a neurologist do the follow-up assessments, though any well-trained sports physician can also act as a case-manager and only refer severe cases to a neurologist (Chermann *et al*., 2014:4). During this time the player must receive the necessary pharmacological intervention including physiotherapy treatment for pain and restoring cervical range of motion (Collins *et al.*, 2014:243). As soon as the player's clinical examination are normal and no concussion symptoms are present then the baseline tests should be repeated to confirm if the player returned to his pre-injury status (Broglio *et al*., 2014:253). If a player has returned to pre-injury state, the RTP exertion protocol can commence. This stepwise progression consist of several stages of physical exertion where the player needs to be symptom free for 24 hours before he can progress to the next stage and ultimately full sports participation (Broglio *et al*., 2014:253).

Collins *et al.* (2014:243) stresses the importance of concussion management via an interdisciplinary team. In this way the myriad of issues connected to sports-related

concussion can be successfully management by a network of care involving sports medicine professionals (Collins *et al*., 2014:243). Physiotherapists are specifically involved in management of the condition, as concussion and whiplash injuries have similar mechanisms of injury (Oliver & Craton, 2013:331). This view is supported by Broglio *et al.* (2014:257) who emphasised the importance of a sports medical team approach when managing a concussed player. However, central to the sport medicine model of interdisciplinary management, is the patient, which emphasises his role and the need for proper education and responsibility regarding injury prevention.

2.4.6 Role of physiotherapy in concussion management

Concussion forms a major part of physiotherapy management in the South African rugby environment. At amateur club or high school rugby level it is rare that a medical doctor will work field-side during a rugby match and therefore the responsibility becomes the physiotherapist's to identify and manage a concussed player on-field. At professional level, a medical doctor will work field-side in combination with a physiotherapist during a rugby match. However, the physiotherapist in this environment still needs to be able to identify a concussed player and report it to the medical doctor for the player to be further assessed and managed in the stadium's medical rooms. As concussion and whiplash injuries have similar mechanisms of injury (Oliver & Craton, 2013:331), physiotherapists are also involved with treatment of players following a concussion. When a concussion occur the brain is exposed to acceleration and deceleration forces inside the skull, due to a physical blow to the head or rest of the body (Echemendia, 2012:208). However the cervical spine also takes strain during a concussion and can mimic concussion symptoms, further resulting in whiplash associated disorders (WAD) (Oliver & Craton, 2013:331). A WAD will further require physiotherapy treatment and rehabilitation for optimal recovery (Sterling, 2014:10).

2.4.7 Concussion education

The Centre for Disease Control (CDC) uses a campaign called *Heads Up* for concussion education (Covassin *et al*., 2012:234). This program uses a variety of educational materials such as booklets, information sheets and CD-ROM. Covassin *et al.* (2012:237) reports that the CDC *Heads Up* campaign was successful in increasing youth sports coaches' knowledge on concussion. Parker *et al*. (2015:203) further evaluated the CDC's *Heads Up* online course and found similar results in showing that it was effective in improving youth sport officials' knowledge on concussion. However these authors only

evaluated knowledge at a single point in time. They did not report on whether the Heads Up campaign can result in long-term transfer of knowledge or behavioural change of removing players from the field when concussed (Parker *et al*., 2015:204).

The Sports Legacy Institute Community Educators (SLICE) program is another educational program which has shown to improve concussion knowledge when evaluated among 636 students (Bagley *et al*., 2012:389). Unfortunately, similar to Parker *et al*. (2015:204), this study evaluated the students' concussion knowledge alone and not if the knowledge will affect their behaviour towards concussion. White *et al*. (2014:6) further stressed their concern. Even though coaches and sports trainers in Australia received education, they still had major misconceptions about concussion especially on how to manage it and facilitate RTP.

Kroshus *et al*. (2015a:245) criticised the use of increased concussion knowledge as a predictor of the effectiveness of concussion educational tools. They argue that concussion knowledge only indicates if the individual paid attention to the given information, but not if it will improve reporting behaviours in-season (Kroshus *et al*., 2015a:245). This is in line with the view of Kurowski *et al.* (2014:15) who states that improved self-report behaviours were not associated with previous concussion education or better knowledge on concussion. In order to obtain effective behavioural change, Kroshus *et al*. (2015a:246) propose adding real life simulation to educational programs in order to help teaching individuals to make safe decisions

Hunt (2015:73) describes how a standard concussion educational video improved students' knowledge on concussion. Their results were based on a pre-test and post-test straight after the video was watched 15 minutes apart. No further follow-up testing was done, therefore no conclusions could be drawn on whether the educational video had lasting behavioural change leading to increased concussion reporting among students (Hunt, 2015:73).

Kroshus *et al.* (2015b:157) reported contrasting results to Hunt (2015:73) regarding educational videos, which resulted in unsafe concussion reporting behaviours among ice hockey players. These videos were shown in a team-environment where big hits resulting in concussions elicited excitement among the players. Kroshus *et al.* (2015b:157) further reports that videos that followed big collisions with sobering content did not elicited the same excitement among the players, emphasising the importance of concussion educational content to be designed population-specific. Scales and Miller

(2003:166) stated that a clinician can't assume that an individual will follow their advice regarding good health behaviours, even if the individual knows that the advice given will have a positive effect on their health. Scales and Miller (2003:167) further describe a technique called Motivational Interviewing (MI) which assist with positive behavioural change towards health. MI consists of five stages of readiness for behavioural change namely a pre-contemplation, contemplation, preparation, action, and maintenance stage. Emphasis was placed on how certain motivation strategies should be used in certain phases of readiness in order to gain effective behavioural change towards health related topics (Scales and Miller, 2003:170). Escolar-Reina *et al.* (2010:7) described in a qualitative study how a healthcare provider's style affects the participant's adherence to clinical advice. Supervised instructions with regular feedback have shown to increase adherence to advice (Escolar-Reina *et al*., 2010:7). This same style could potentially affect players' behaviour and knowledge regarding concussion and RTP guidelines.

2.5 CONCUSSION KNOWLEDGE AMONG RUGBY PLAYERS

Only a few studies have researched rugby player's knowledge on concussion. Sye *et al*. (2006:1004) evaluated 477 New Zealand based high school rugby players and emphasised the lack of knowledge about concussion. Even though the players had a fundamental understanding of what constitutes a concussion, less than 50% of the players knew about concussion and only 22% of the players that did consult medical professionals waited until they were medically cleared before returning to play. One would expect these results to improve, however five years later a study done on amateur rugby players in Italy showed similar results. Boffano *et al*. (2011:2053) described how 38.5% of the players have never been informed about concussion. Among the "informed" players there were three players that were convinced they could return to the field straight after sustaining a concussion. Walker (2015:50) tested concussion knowledge and RTP attitudes among 127 sub-elite South African rugby players. Regarding what constitutes a concussion these players had a high-level of knowledge showing contrasting results to Sye *et al*. (2006:1003). Players who had a previous history of concussion had superior knowledge, potentially indicating that knowledge comes from personal experience rather than from education (Walker, 2015:53). This finding is supported by Baker *et al.* (2013:126) who indicated that there is a direct correlation between the number of concussions a player sustained and the number of concussion symptoms he can correctly identify on the questionnaire.

Although a higher level of understanding to what constitutes a concussion was found by Walker (2015:54) compared to Sye *et al.* (20061003), these two studies still showed similar results regarding RTP attitudes among participants. Less than half of the South African players reported that they will wait until fully recovered from a concussion before returning to full participation (Walker, 2015:53). Delahunty *et al*. (2015:23) took a similar stance and stated that concussion knowledge is not directly related to changes in behaviour towards concussion. The Irish youth rugby players used in their study showed a tendency to keep on playing while concussed, even though they had knowledge of concussion (Delahunty *et al*., 2015:24). Baker *et al*. (2013:124) showed similar results to these two studies and reported how a quarter of their study sample kept on playing rugby while knowingly concussed.

2.6 CONCUSSION KNOWLEDGE AND ATTITUDES OUTCOME MEASURES

The Knowledge and Attitudes about Sports Concussion Questionnaire-24, also known as KASCQ-24, is an outcome measure designed to evaluate concussion knowledge and RTP attitudes. This questionnaire largely focus on concussion knowledge and is limited in questions pertaining to attitudes and behaviour regarding concussion (Rosenbaum & Arnett, 2010:45). The Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) consists of the Concussion Knowledge Index (CKI) and Concussion Attitudes Index (CAI) and a symptom recognition section. This questionnaire was found to be valid and reliable in testing knowledge and attitudes towards concussion following vigorous psychometric evaluation (Rosenbaum & Arnett, 2010:53). The RoCKAS-ST not only refers to concussion attitudes in general, but also a detailed description of specifically the coach, athletic trainer, teammate and player's attitude and behaviour regarding concussion within the context of described scenarios.

Williams (2013:19) described a modified RoCKAS-ST as a further improvement on the original questionnaire. The RoCKAS-ST questionnaire has a Cronbach's alpha of 0.76 (Williams, 2013:19). However section five of the RoCKAS-ST questionnaire has been replaced by a 16-symptom recognition checklist as it has a Cronbach's alpha of 0.83 (Williams, 2013:19). Therefore by adding the 16-symptom recognition checklist the reliability and validity of the questionnaire were improved.

2.7 CONCLUSION

Rugby is a contact sport with a high risk for injury (Carter, 2015:1). Concussion in particular, has a high incidence among all ages and levels of rugby players (Gardner *et al.*, 2014:1726). Considering that rugby players has shown to have poor knowledge and unsafe attitudes/behaviours towards concussion, the potential long-term neurological effects following a concussion and potentially serious consequences of mismanagement made this condition a regular debated topic. As stated by Benson *et al*. (2013:5), there is no current evidence to support that protective equipment can prevent a concussion, therefore the emphasis have moved to concussion awareness and education programmes. The main aim of these programmes are ultimately to promote safe attitudes and behaviours towards concussion and RTP, although convincing literature to confirm the efficacy of such programmes remains scarce. Currently in South Africa the *Boksmart* programme focus on education of coaches and referees. Walker (2015:50) stated that South African rugby players had less than optimal knowledge on concussion and RTP before fully recovered.

Therefore, further research on concussion knowledge among rugby players are warranted to generate benchmark data needed to inform development and motivate implementation of educational programmes among rugby players, as an addition to the current *BokSmart* programme.

CHAPTER 3
METHODOLOGY

3.1 INTRODUCTION

This chapter describes the study design used in order to conduct the study on concussion knowledge among South African rugby players. A detailed outline is given on the specific population included in the study and the eligibility criteria for both the senior amateur and junior amateur groups. The composition of the Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) questionnaire is discussed in combination with the scoring systems used. Further insight is given into the data analysis procedures and the envisaged implementation of the findings from the study.

3.2 STUDY DESIGN

This study used a descriptive, cross-sectional study design to achieve the aim set out in Section 1.2. This study design allowed data to be collected at one point in time in order to describe a phenomena or relationship between variables (Brink *et al.,* 2012:210). Advantages of this study design are that it is inexpensive to conduct and not time consuming, allowing the researcher to study larger sample sizes (Levin, 2006:25). In Addition, no data can be lost due to unsuccessful follow-ups and an assessment of a variety of outcomes are possible (Levin, 2006:25). However, this study design also has disadvantages. It is challenging to make casual inference using this study design and Neyman bias (prevalence-incidence bias) could potentially occur (Levin, 2006:25).

3.3 PARTICIPANTS

3.3.1 Target population

A population refers to a set of persons of interest to the researcher, which possess similar characteristics (Brink *et al*., 2012:216). The target population consisted of two groups namely the senior amateur (club) and junior amateur (high school) South African rugby players. The Gauteng province hosted three provincial rugby unions, the Golden Lions

Rugby Union (GLRU), Blue Bulls Rugby Union (BBRU) and the Falcons Rugby Union (FRU). All three provincial unions had organised club rugby leagues. Clubs involved in these leagues, who had an official website with contact details were contacted and their players were approached to participate in this study. Twelve rugby clubs met the criteria for inclusion, of which six clubs agreed to participate in the study. At the time of the study, over 200 rugby playing high schools existed within the Gauteng province which enabled a randomised sample selection for possible inclusion in this study. A simple computerised randomisation technique was used to choose 30 high schools which were contacted for participation in this study. As a single researcher was responsible for all data collection, only 30 schools were chosen for the study to be feasible. Of the 30 schools, seven schools agreed to participate in the study. The eligibility criteria for participants to be included in the study are discussed under Section 3.3.3.

3.3.2 Sample population

3.3.2.1 Junior amateur high school (JAHS) group

From the 30 schools approached, only seven high schools gave permission for their players to be approached to participate in this study. From these high schools, 216 players participated in the study by completing a questionnaire (Appendix A) regarding the individual player's knowledge and attitudes/behaviours towards concussion and return to play (RTP).

3.3.2.2 Senior amateur club (SAC) group

A total number of five rugby clubs gave permission for their players to be approached. From these clubs, 78 players agreed to participate in this study by completing a questionnaire (Appendix A), assessing the individual player's knowledge and attitudes/behaviours towards concussion and RTP. Players were included in the study if they fulfilled the following eligibility criteria.

3.3.3 Eligibility criteria

Participants from the senior amateur group had to be registered as a South African rugby player during the 2015 club rugby season. Further all participants were registered at a rugby club in the Gauteng province. These participants were amateur rugby players not earning a monthly salary for playing rugby. Participants had South African citizenship

and all races were included. They had played at least one game for the club during the 2015 season. All participants were males and be able to understand English.

Participants from the junior amateur group had to fulfil a separate set of eligibility criteria. They were playing at under 14, 16 or 18 age levels. All participants were registered as South African rugby players during the 2015 season. Participants were also registered at a high school in the Gauteng province. All participants were schoolboy amateur rugby players, not earning a monthly salary for playing rugby. Participants had to have South African citizenship and all races were included. Participants had played at least one game for the school during the 2015 season. All participants were male and be able to understand English.

3.4 ETICAL ASPECTS

3.4.1 Ethical approval

Before commencement of the study, ethical clearance was obtained from the Health Ethics Committee of the faculty of Health Sciences at the University of the Free State (UFS) ECUFS NR 105/2015 (Appendix B). Further permission was obtained from the South African Rugby Union (SARU) (Appendix C) and the Gauteng Department of Education (GDE) (Appendix D). This consent was a prerequisite for ethical clearance.

3.4.2 Information to participants

Information about the study was provided to all participants before they had the opportunity to make an informed decision on whether they want to participate in the study or not. The researcher personally gave the senior amateur players a set body of information before they completed the questionnaires. The researcher provided the rugby organisers at participating high schools with a set body of information (Appendix E) to communicate to the players before they had the chance to fill in the questionnaire.

3.4.3 Informed consent

As participants were not required to fill in a name on the questionnaire they remained totally anonymous. Participation in the study was voluntary and after receiving information about the study each participant had the opportunity to make an informed

decision on whether they wanted to participate or not. As all participants remained anonymous, this method of consent was satisfactory as stated by the Health Ethics Committee of the faculty of Health Sciences at UFS.

3.4.4 Implementation of findings

Results of the study will be reported to the schools, clubs and heads of the Ambulance Services to facilitate better understanding and treatment of the concussed child, and if needed to facilitate increased training in concussion. An envisaged publication would raise awareness of the medical responsibility placed on role players other than doctors, as well as the knowledge and practices of different role players dealing with a concussed child. This study could also be used to provide feedback for sport concussion prevention and management programmes regarding their programmes to certify rugby coaches at school level and motivate for continuing medical education (CME) in the case of the doctors.

3.5 MEASUREMENT

3.5.1 Measurement instrument

A modified Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) questionnaire (Appendix A) as described by Williams (2013:19) was used in this study to assess knowledge and attitude/behaviour regarding concussion injuries and RTP. The original RoCKAS-ST questionnaire consisted of five different sections, however in this study only four sections were used as part of a modified RoCKAS-ST questionnaire. Section five (RoCKAS-ST symptoms) of the original RoCKAS-ST was replaced by a 16-symptom recognition checklist to form the modified RoCKAS-ST questionnaire. This modified RoCKAS-ST questionnaire has been successfully used in previous literature (Williams, 2013:19). The Concussion Knowledge Index (CKI) and Concussion Attitudes Index (CAI) also formed part of the questionnaire to give further insight into the players' attitudes/behaviours and knowledge about concussions and RTP. This combination of questionnaires have been used in previous literature with significant results (Williams, 2013:19).

3.5.2 Scoring of the questionnaire

The first two sections of the questionnaire consist of true/false questions. The CKI had 25 questions that consisted of 17 true/false questions. These 17 true/false questions of the CKI was included in the modified RoCKAS-ST questionnaire. One point was given for a correct answer and no points for an incorrect answer (Williams, 2013:19). Section three and four consisted of 18 questions in total which are rated on a five-point Likert scale. These questions were derived from the CAI. In section three and four a participant could choose from five different options namely: 'strongly disagree', 'disagree', 'neutral', 'agree' or 'strongly agree'. To assess the ordinal data from the CAI questions, the data were trichotomised into safe, neutral and unsafe responses and attitudes. A moderately unsafe response referred to the options 'disagree' or 'agree' depending on the statement made at the particular question. For a moderately unsafe response a participant would score two points. A very unsafe response referred to the options 'strongly disagree' or 'strongly agree', depending on the statement made at the particular question. For a very unsafe response a participant would score one point. A neutral response scored three points while a moderately safe and very safe response scored four and five points respectively. Safer attitudes/behaviours towards concussion were indicated by higher scores. A validity scale (VS) was included in the questionnaire and consists of three questions randomly spread between the sections. For a correct answer the participant received one point and no points for an incorrect answer. A participant's data was likely to be invalid if a score of zero was achieved.

3.5.3 Validity and reliability

The RoCKAS-ST questionnaire had a Cronbach's alpha of 0.76 (Williams, 2013:19). However in this study section five of the RoCKAS-ST questionnaire had been replaced by the 16-symptom recognition checklist as it has a Cronbach's alpha of 0.83 (Williams, 2013:20). Therefore by adding the 16-symptom recognition checklist, the reliability and validity of the questionnaire were improved. Williams (2013:19) also added the CKI and CAI to the questionnaire. The CAI have a Cronbach's alpha of 0.79, which also contributed to the validity and reliability of the questionnaire. Five participants in study sample scored zero on the validity scale. Two of these participants formed part of the JAHS group and three of the SAC group. In total these five participants made up 1.7% of the sample. Their data were included in the study as such a small percentage does not significantly affect the results. The validity scale provides the researcher with a guideline of zero showing a participant's data to potentially be invalid.

Table 3.1 Validity Scale of the JAHS and SAC groups

Validity Scale	0 score	(n)	% of group
JAHS	2	216	0.93
SAC	3	78	3.85
Total population	5	294	1.7

3.6 PILOT STUDY

A pilot study was done to further identify possible errors and to ensure that the questionnaire (Appendix A) and demographic data form (Appendix F) were understandable, recorded data effectively and included enough detail to make conclusions about South African rugby players' knowledge about concussion. The pilot study further helped the researcher to determine that completion of the questionnaire takes between 15 and 25 minutes. Wording were corrected as found in the RoCKAS-ST provided by Williams (2013:119) as South Africans do not use the word "freshman" to refer to a first year university student.

Six rugby players from a rugby club in Bloemfontein were used for the pilot study sample. The aims of the pilot study were explained to them and they had the chance to voluntarily participate in the study by filling in a questionnaire. These players remained anonymous during testing. None of these players' data were included in the main study. Data obtained during the pilot study was therefore not included in the final results.

3.7 DATA COLLECTION

3.7.1 Data collection procedures

As mentioned in Section 3.4.1, permission to conduct the study on South African rugby players were obtained from SARU (Appendix C) before the data collection commenced. Further permission was obtained from the GDE (Appendix D) due to the inclusion of high school scholars in the study. This consent was a prerequisite for ethical clearance as described in Section 3.4.1.

The senior amateur group was visited personally by the researcher at the respective rugby clubs. The clubs were given two weeks' notice in advance of the visit. The study was explained to the participants and they had the chance to voluntarily participate in the study. No written informed consent was required as advised by the Ethics committee at the UFS Health Sciences department. This was due to the fact that no participant was required to fill in their name on the questionnaire and therefore the participant remained anonymous.

The high schools of the junior amateur groups were visited personally by the researcher. The school was notified one week in advance of the researcher's visit. During this visit the study was explained to the respective schools' rugby organisers. Exact guidance was given to the participants in order to explain the study to them and to be able to answer any questions the participants may have regarding the questionnaire. Due to different class schedules and after school practice times, it was impossible for the researcher to test all age group teams of a school in one visit. Therefore the rugby organisers was given a period of two weeks to allow time slots for each age group to fill in the questionnaires. As with the senior amateur group no written informed consent was needed (from participant or parent) as the participant remained totally anonymous and had a choice if he wanted to fill in the questionnaire or not (as advised by the Ethics committee at the UFS Health Sciences Faculty).

3.7.2 Measurement errors

Several attempts were made by the researcher to give a true reflection of the target population's knowledge by trying to avoid systematic and random errors from occurring.

Systematic errors in the form of non-observational errors were limited as the researcher had informed the club or high school in advance about the visit. This gave the management personnel time to inform the players of the visit so that they could arrange to be present on the day. Therefore the recorded data is a true reflection of the specific team's knowledge about concussion. Observational errors could also occur where the participants may have guessed in their answers as they felt exposed. The questionnaire however was designed to test their knowledge using multiple choice answers. They would be able to guess an answer, but not lie about it as there were no open-ended questions. Emphasis was also placed on the fact that every participant's information remained confidential to encourage honest answering of questions. The questionnaire's validity has been proven in previous studies.

Random errors also had to be considered. Some amateur players may have previously played rugby in a professional setup and gained knowledge about concussions due to exposure to a medical team. Even though they played previously at professional level they were still recorded as amateurs due to the fact that they formed part of that specific population at the time of execution of the study.

3.8 DATA ANALYSIS

Descriptive statistics were used to summarise continuous data with means and standard deviations or medians and percentiles as appropriate. Frequencies and percentages were calculated for categorical data while significance was set at $p < 0.05$ for comparative analyses. Statistical analyses were done by the Department of Biostatistics at UFS.

3.9 CONCLUSION

This study used a descriptive, cross-sectional study design to investigate concussion knowledge and attitudes/behaviours towards concussion and RTP among amateur South African rugby players. A modified RoCKAS-ST questionnaire was used to achieve the aims. Permission to conduct the study were granted by SARU and the GDE, while ethical approval was obtained from the Health Ethics Committee of the faculty of Health Sciences at the UFS.

In the following chapter, a detailed description of the study results are presented. The results were categorised under demographic data, concussion knowledge and concussion attitudes/behaviours.

CHAPTER 4
RESULTS

Results obtained from the modified Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) questionnaire have been reported in this chapter. Section 4.1 focused on demographic data of participants of the junior amateur high school (JAHS) and senior amateur club (SAC) groups. Section 4.2 more specifically reported on concussion knowledge of the participants distinguishing between the SAC and JAHS groups. In Section 4.2 the participants' ability to recognize symptoms of concussion were also discussed. Furthermore, Section 4.3 focussed on the participants' attitudes/behaviours regarding concussion and return to play (RTP).

4.1 DEMOGRAPHICS

In total 294 participants filled in questionnaires. The JAHS formed 73.5% (n = 216) of the study sample while the remaining 26.5% (n = 78) of the total study sample consisted of the SAC group. The JAHS group had a mean player mass of 76.8 kg (± 15.9 kg) and 21.30% (n = 46) of these junior players weighed 90 kg or more. The SAC group had a mean mass of 86.8 kg (± 17.6 kg) with 35.9% (n = 28) of the players weighing 90 kg or more. The mean body mass index (BMI) of the JAHS group was 24.5 (± 4.1) kg/m^2 compared to 28 (± 4.2) kg/m^2 found in the SAC group. An equal mean player height with standard deviation of 1.7 m (± 0.1) were noted among the two groups.

4.1.1 Age distribution

The JAHS participants' ages ranged between 13 and 19 years old. This group largely consisted of under 16 level players (56.9%, n = 123) followed by under 14 (24.5%, n = 53) and under 18 level players (18.5%, n = 40) (Figure 4.1). In rugby the age level group of under 18 level includes players that are 17 and 18 years old. If a player turns 18 in that year then he will still participate as an under 18 level player. The same principle is applied to the other age level groups.

The SAC group participants' ages ranged between 17 and 28 years old. However six participants of the SAC group did not indicate in what age group they participate. Only 25 (34.7%) players in this group were 21 years or older (Figure 4.1).

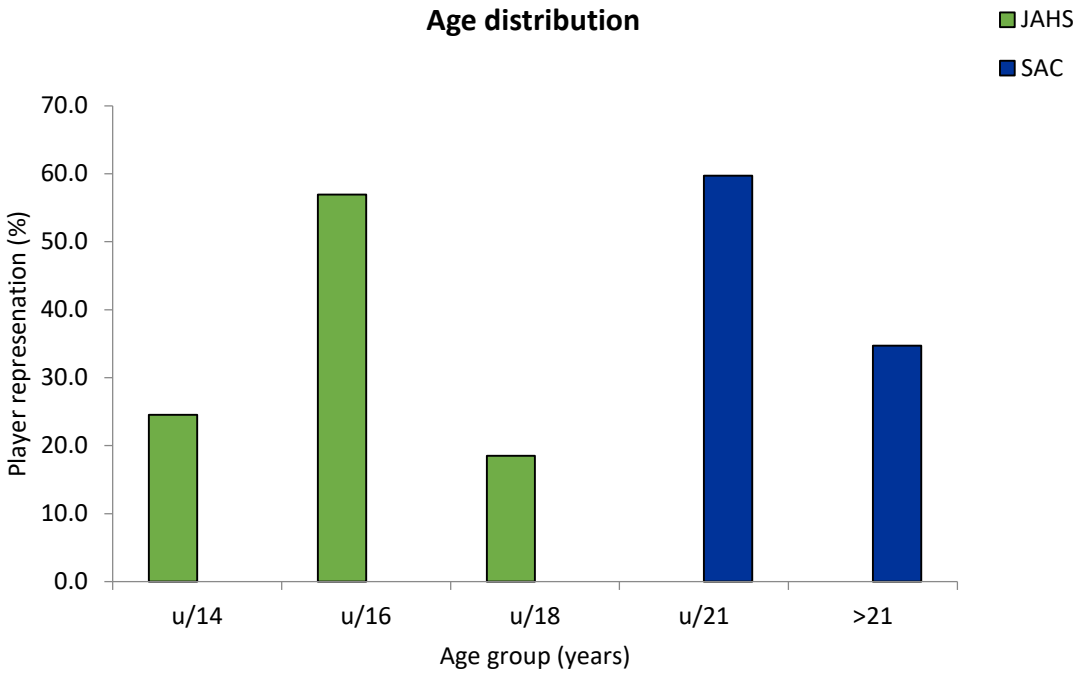

Figure 4.1 Age distributions of JAHS (n = 216) and SAC (n = 72) participants.

4.1.2 Participants' rugby player positions

The study sample had a relative even spread among player positions as seen in Figure 4.2, however the largest part of the study sample consisted of front row players (n = 70, 23.8%). This positional group includes the tight head prop, loose head prop and hooker as position. Specifically the JAHS had a large number (n = 56) of front row players participating, forming 25.9% of the total group. The back three positional group was the second largest (n = 55, 18.7%) and includes the fullback, left-and right wing positions.

In the SAC group, the back three had the largest number (n = 21, 26.9%) of participants. The loose forward positional group formed 15.3% of the study sample and consisted of the open-side flanker, blind-side flanker and eight man positions. Further the second row and centre positional groups had nearly similar participant numbers, forming 14% and 13.3% of the total study sample respectively. The scrumhalf and fly-half groups consisted of only one position per group and showed the smallest number of participants with scrum-halfs forming 8.8% and fly-halfs 6.1% of the study sample.

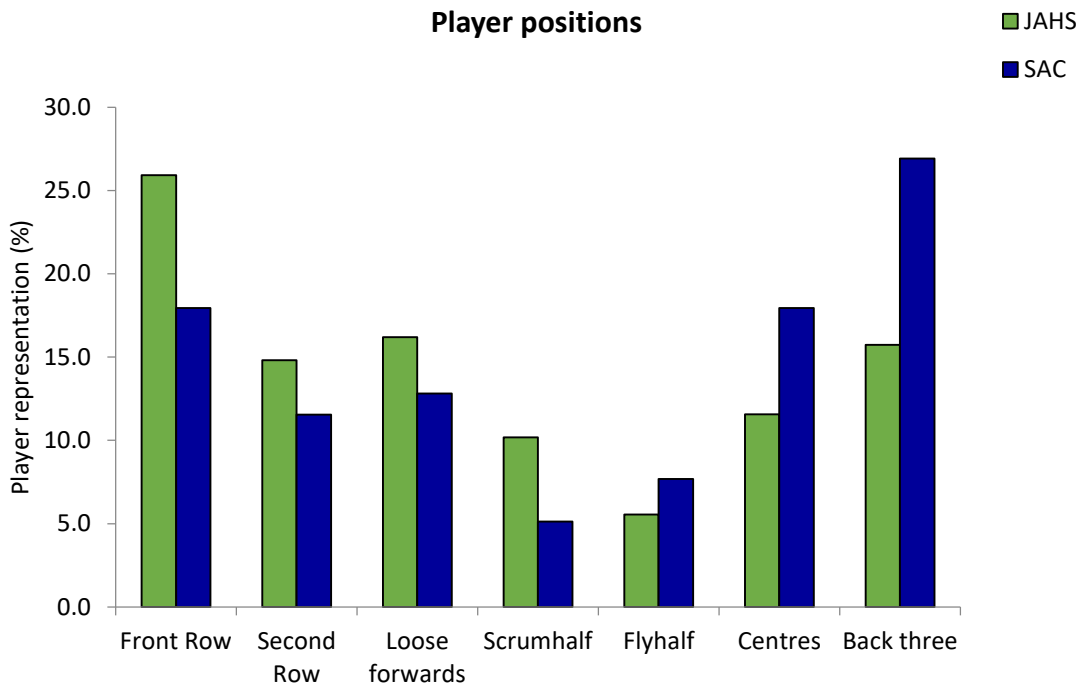

Figure 4.2 *Player position distributions of the JAHS (n = 216) and SAC (n = 78) participants.*

4.1.3 Rugby playing experience

Participants of the JAHS had a median rugby playing experience of 8 years (Q_1 = 7; Q_3 = 10). Most (89%) of the JAHS participants had at least five years or more experience. Among the senior players forming the SAC group there were a median of 10 years (Q_1 = 6; Q_3 = 15) of rugby playing experience with 21 years recorded as the most years of playing experience among the SAC participants. Further, 81.8% of the SAC participants had five years or more rugby playing experience which is marginally less compared to 89% of the JAHS group who had similar playing experience.

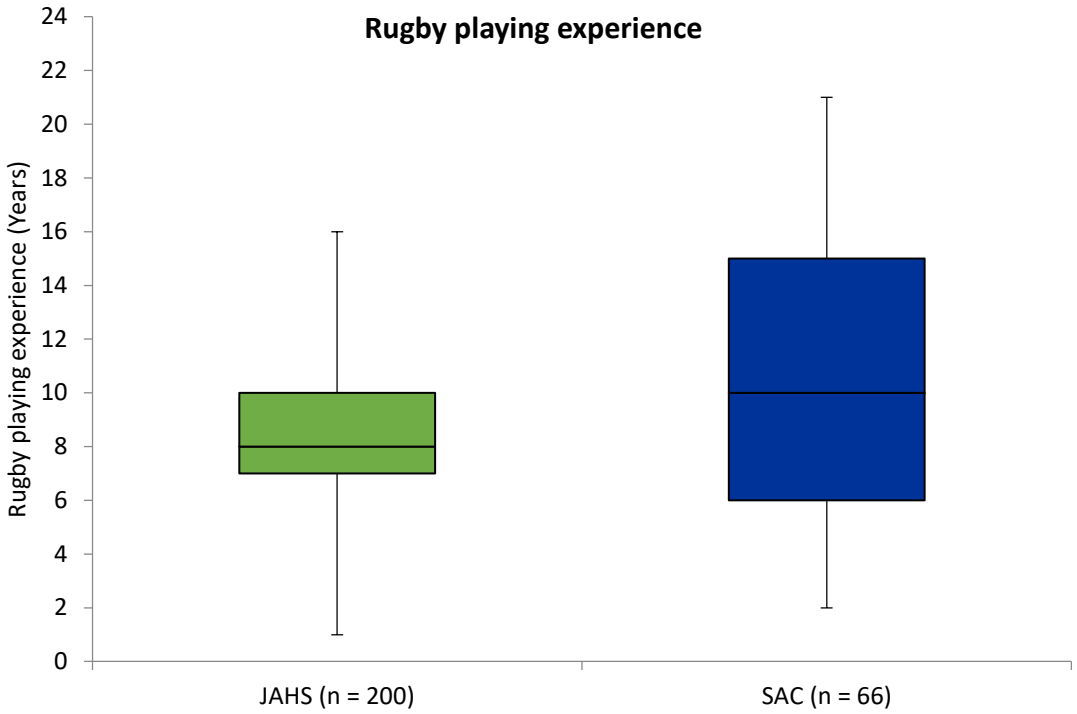

Figure 4.3 *Number of years the JAHS and SAC participants have been playing rugby.*

4.1.4 Concussion histories

The medical history specifically included questions regarding concussion injuries. As illustrated in Figure 4.4, a total of 71 JAHS and 32 SAC participants reported a previous concussion sustained through participation in rugby. From the 71 JAHS participants with a history of concussion and player position information available, 33.9% (n = 19) were front row players, which was a similar proportional representation compared to the 35.7% (n = 5) front row players from the 32 SAC participants who reported a history of concussion. The JAHS second row positional group showed the highest percentage with 43.8% (n = 14) of second row participants reported sustaining a previous concussion. The SAC second row positional group also showed the highest percentage with 66.7% (n = 6) of the second row participants reported sustaining a previous concussion. Both study groups showed a low number of reported concussions among the fly-half positional group. In the JAHS fly-half positional group 25% (n = 3) of participants sustained a previous concussion while only 16.7% (n = 1) of SAC fly-half participants sustained a previous concussion. A particular high percentage (64.3%, n = 9) of the SAC centre positional group sustained a previous concussion.

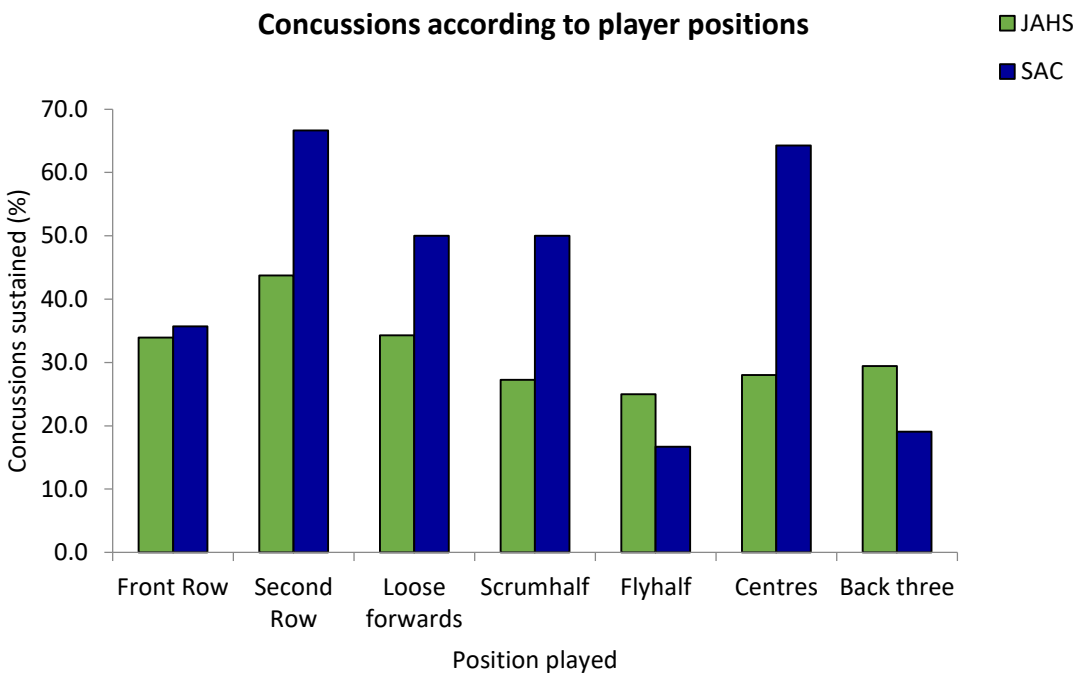

Figure 4.4 *Positional prevalence of previous concussions sustained by the JAHS (n = 61) and SAC (n = 22) participants*

From Figure 4.5 it is noted that 42.6% (n = 26) of the JAHS participants that reported a previous history of concussion, sustained only one concussion in their rugby career. Looking at the SAC group, only 36.4% (n = 8) of the SAC group that reported a previous history of concussion, sustained one previous concussion. Among the JAHS participants the percentage of reported concussion showed a gradual decline with increased number of reported concussions. Of those participants who reported a previous history of concussion, 31.1% (n = 19) had two concussions, 18% (n = 11) had three and 6.6% (n = 4) had four previous concussions. One participant (1.6%) even reported a previous history of seven concussions. Among the SAC participants that sustained a previous concussion, 22.7% (n = 5) reported sustaining three previous concussions while 18.2% (n = 4) sustained two concussions and the same percentage (18.2%, n = 4) sustained four concussions. The highest number of concussions sustained among the SAC participants were five, with 4.5% (n = 1) of participants that sustained a previous concussion reporting this number.

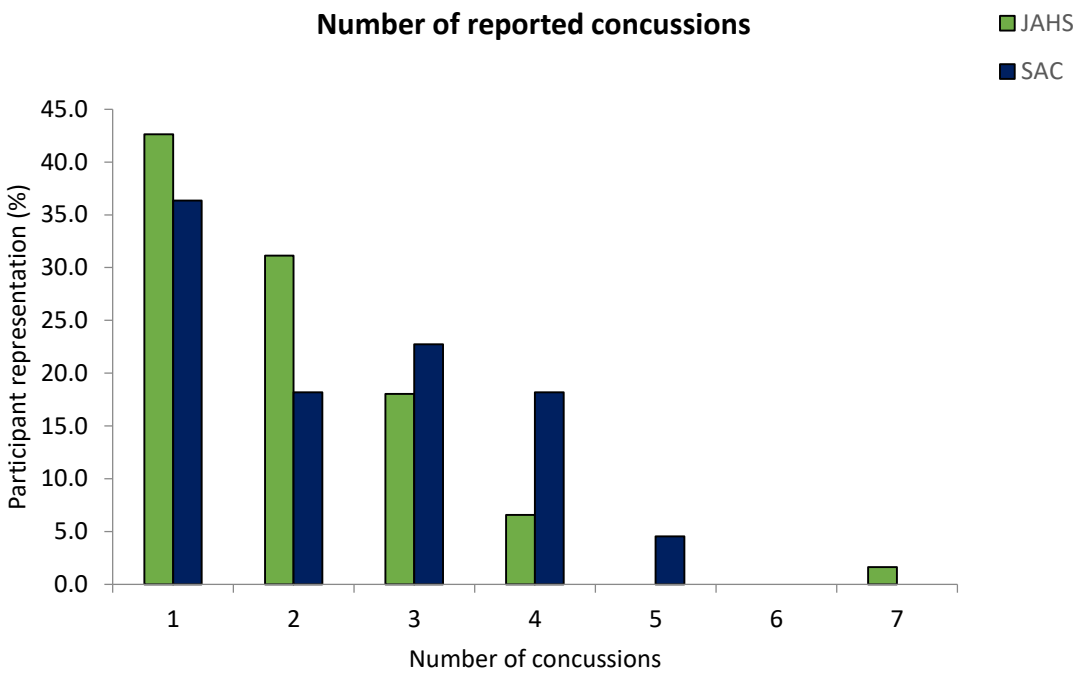

Figure 4.5 *Number of concussions reported by the JAHS (n = 61) and SAC (n = 22) players*

4.1.5 Concussion information received

Not all participants in the study sample previously received information relating to concussion. Only 45.9% (n = 133) of participants have received some form of information on concussion. The SAC group was better informed with 58.7% (n = 44) of participants having received information on concussion compared to the 41.4% (n = 89) of participants in the JAHS group.

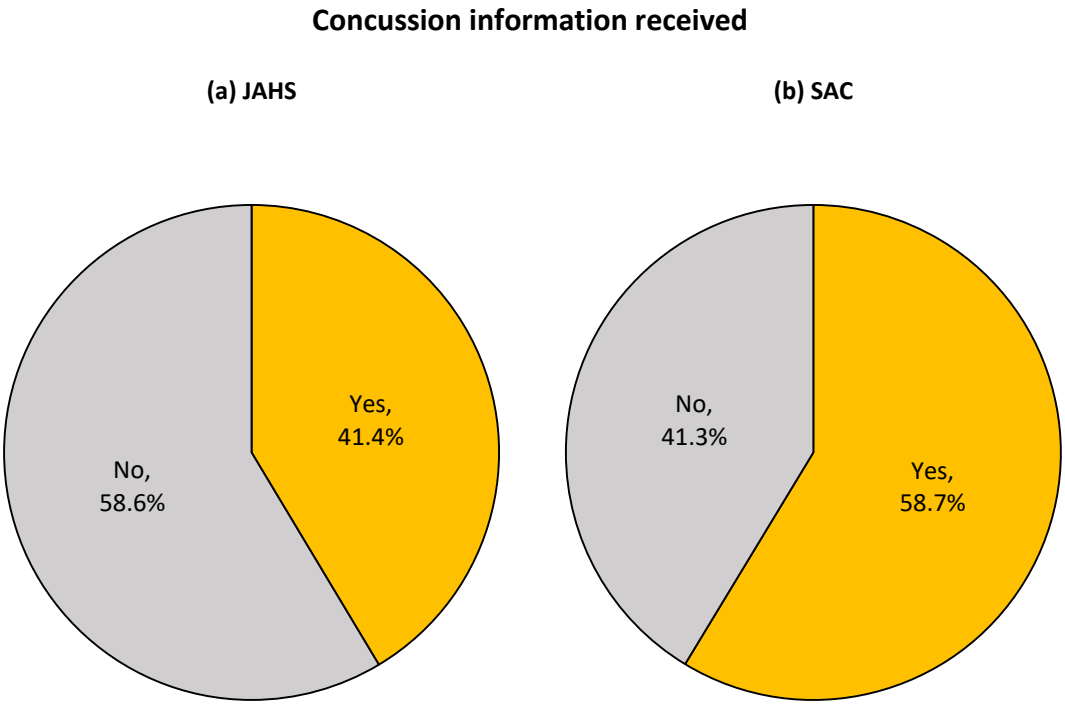

Figure 4.6 *Concussion related information received by the **(a)** JAHS (n = 215) and **(b)** SAC (n = 75) participants.*

Participants received information on concussion from various sources. Health care professionals (medical doctor, physiotherapist and nurse) played the biggest role as source of information to this specific study sample. It was reported that 42.2% (n = 43) of participants that received information on concussion, reported health care professionals as their source. The JAHS group specifically received the majority of information from health care professionals as 47.2% (n = 34) of participants gained information via this source. The SAC participants gained their majority of information at the previous school they attended as indicated by the 33.3% (n = 10) of participants that received information on concussion reporting their previous school as source. Coaches did not play a major role in informing players as only 6.7% (n = 2) of the SAC participants and 13.9% (n = 10) of the JAHS participant reported coaches as their source of information on concussion.

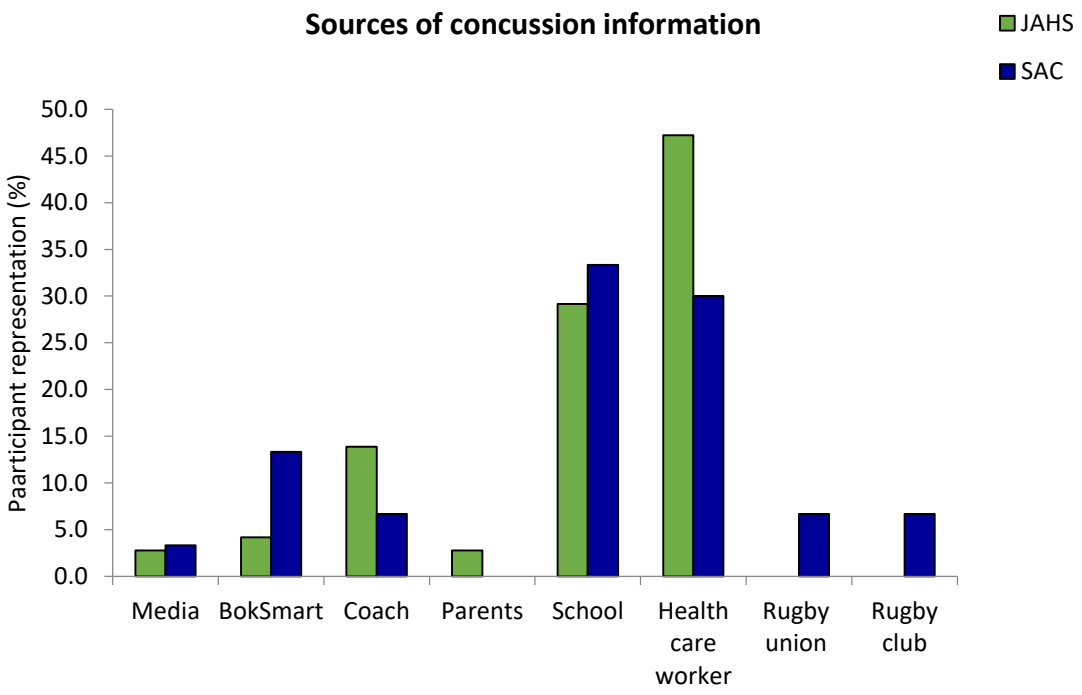

Figure 4.7 *Sources of information on concussion received by the JAHS (n = 72) and SAC (n = 30) participants.*

4.2 CONCUSSION KNOWLEDGE

4.2.1 Concussion Knowledge Index (CKI)

The knowledge on concussion may play a role in determining the source of information as well as management of the concussion. The CKI mean in the JAHS group was 10.46 ± 2.36 (range 3 – 15) of a maximum score of 17 points. Participants of the JAHS on average identified 62.4% of the CKI questions correctly.

Referring to the CKI results displayed in Table 4.1.a, four of the knowledge questions were correctly identified by more than 80% of the JAHS participants. The loss of intelligence after sustaining one concussion, were correctly identified as “false” by 86% (n = 184) of the JAHS participants. This question had the highest percentage of participants correctly identifying the answer. The fact that sustaining repeated concussions will affect a player’s long-term health and well-being, were correctly identified as “true” by 81.9% (n = 176) of participants. The risk of death when sustaining a concussion while already concussed, were correctly identified by 81.7% (n = 170) of

participants and a further 80.3% (n = 171) of participants agreed that concussion symptoms can last for several weeks.

The most common misconception was that a concussion can be identified via brain imaging, showing physical brain damage. Only 23.3% (n = 50) participants of the JAHS group answered this question correctly. The increased risk of multiple concussions affecting a player's long-term health and well-being were incorrectly answered as "false" by a large number of participants (n = 145, 67.8%). The participants also had a misconception on the mechanism of concussion injury as 62.7% (n = 133) of participants believed that a concussion can only be sustained via a direct hit to the head.

The CKI mean in the SAC group was 10.17 ± 2.35 (range 4 – 14) of a maximum score of 17 points. Participants of the SAC on average identified 60.2% of the knowledge questions correctly.

As reported in Table 4.1.a, three questions were answered correctly by 80% or more participants of the SAC group. As with the JAHS group, the question most commonly identified correctly by participants were that there is no link between a single concussion sustained and loss of intelligence. Among the SAC participants 93.6% (n = 73) answered this question correctly. The fact that memory function does not improve after sustaining a second concussion were correctly identified by 80.8% (n = 63) of participants. Eighty percent (n = 60) of participants correctly agreed that concussion symptoms can last for several weeks.

As with the JAHS group, a common misconception among the SAC participants were that a concussion can be diagnosed via brain imaging showing visible brain damage. Only 18.7% (n = 14) of participants knew that this statement was incorrect. As discussed before, the JAHS showed a large difference in percentage of correct answers seen between questions asked in Sections 1.18 and 2.2 of the CKI. These questions that referred to the long-term health and well-being of a player after sustaining multiple concussions, were answered more consistently in the SAC group. Section 1.18, which was a statement, was answered correctly by 53.3% (n = 41) of the SAC sample compared to 32.2% (n = 69) of the JAHS group. Section 2.2 was answered correctly by 66.7% (n = 52) of the SAC participants. The SAC group also had a misconception on the mechanism of concussion injury as more than half (57.1%, n = 44) of the participants believed that a concussion could only be sustained through a direct hit to the head.

Table 4.1.a Concrete statements evaluating the Concussion Knowledge Index (CKI) of the JAHS and SAC groups

	Statement	JAHS		SAC	
		n	% correct	n	% correct
True statements	There is a possible risk of death if a second concussion occurs before the first one has healed	208	81.7	73	76.7
	People who had one concussion are more likely to have another concussion	215	65.6	77	48.1
	Symptoms of a concussion can last several weeks	213	80.3	75	80
	After 10 days, symptoms of a concussion are usually completely gone	213	60.1	78	52.6
	Concussions can sometimes lead to emotional disruptions	214	71.5	76	65.8
	An athlete who gets knocked out after getting a concussion is experiencing a coma	209	38.3	76	36.8
False statements	In order to be diagnosed with a concussion you have to be knocked out	214	79.0	76	73.7
	A concussion can only occur if there is a direct hit to the head	212	37.3	77	42.9
	Being knocked unconscious always causes permanent damage to the brain	213	70.4	75	66.7
	Sometimes a second concussion can help a person remember things that were forgotten after the first	211	67.8	78	80.8
	After a concussion occurs, brain imaging (CAT scan, MRI, X-ray etc.) typically show visible physical damage (bruise, blood clot) to the brain	215	23.3	75	18.7
	If you receive one concussion and you have never had a concussion before, you will become less intelligent	214	86	78	93.6
	After a concussion, people can forget who they are and not recognise others but be perfect in every other way	212	44.3	77	27.3
	There is rarely a risk to long-term health and well-being from multiple concussions	214	32.2	77	53.3

Table 4.1.b Scenario statements (Appendix A) evaluating the Concussion Knowledge Index (CKI) of the JAHS and SAC groups

Scenario	Statement	JAHS		SAC	
		n	% correct	n	% correct
1	It is likely that player Q's concussion will affect his long-term health and wellbeing	215	65.1	77	68.8
	It is likely that player X's concussion will affect his long term-health and wellbeing	215	81.9	78	66.7
2	Even though player F is still experiencing the effects of the concussion, his performance will be the same as it would be had he not suffered a concussion	213	76.1	78	71.8

The concussion knowledge of the JAHS group has shown to be marginally higher to that of the SAC group. During a comparison of the JAHS and SAC groups, no statistical significance were found between their mean concussion knowledge scores ($p > 0.37$). The JAHS group on average answered 62.4% of the questions correctly while the SAC correctly answered 60.2% of the questions. Even though very similar mean concussion knowledge percentages were noted, in two scenarios a reported percentage difference of 15% or more appeared. Only 48.1% of the SAC participants acknowledged the increased risk of sustaining a concussion following a previous concussion compared to the 65.6% of SAC participants. The potential presence of amnesia following a concussion as the only presenting symptom was directly identified as false by only 27.3% of the SAC participants compared to 44.3% of the JAHS participants. Both groups had the highest percentage of correct answers when identifying that a single concussion will not make a player less intelligent.

4.2.2 Concussion symptom identification

The importance of acquiring knowledge about concussion would be to identify symptoms and signs which could put a player at risk. Participants of the JAHS group most commonly identified headache correctly as a symptom of concussion as seen in Table 4.2. Specifically 84.3% (n = 182) of participants correctly identified this symptom while 15.7% (n = 34) did not manage to recognize headache as a symptom of concussion. The second most common symptom identified by 83.8% (n = 181) of participants, was dizziness. Confusion was the third most commonly identified symptom, with 77.3% (n = 167) of participants recognizing it as a symptom of concussion.

Actual symptoms of concussion that were poorly identified by the JAHS participants were sleep disturbance, loss of consciousness and nausea. Sleep disturbance as a symptom was only identified by 38.4% (n = 83) of participants followed by loss of consciousness 47.2% (n = 102) and nausea 56.9% (n = 123). Participants of the JAHS group on average identified the symptoms of concussion correctly 66.3% of the time.

Table 4.2 Concussion symptom identification - capabilities of the JAHS and SAC groups

	Symptom	JAHS (n = 216)	SAC (n = 78)
		% correct	% correct
IS a symptom	Amnesia (memory loss)	69.4	57.7
	Blurred vision	73.2	71.8
	Confusion	77.3	69.2
	Dizziness	83.8	70.5
	Headache	84.3	76.9
	Loss of consciousness	47.2	56.4
	Nausea	56.9	51.3
	Sleep disturbance	38.4	47.4
IS NOT a symptom	Abnormal sense of smell	91.7	88.46
	Abnormal sense of taste	88.4	87.18
	Black eye	90.7	85.90
	Chest pain	83.3	91.03
	Nosebleed	72.7	84.62
	Numbness/Tingling in upper extremity	79.2	75.64
	Sharp burning pain in neck	84.7	84.62
	Weakness of neck range of motion	59.3	60.26

Similar to the JAHS group, participants of the SAC group most commonly identified headache as a symptom of concussion. Approximately 77% (n = 60) of participants managed to correctly identify this symptom. Blurred vision and dizziness were the second and third most commonly identified symptoms with 71.8% (n = 56) of participants recognizing blurred vision and 70.51% (n = 55) dizziness.

Concussion symptoms that were most commonly not identified were sleep disturbance, nausea and loss of consciousness. Sleep disturbance as a symptom was only recognized by 47.4% (n = 37) of participants followed by nausea 51.3% (n = 40) and loss

of consciousness 56.4% (n = 44). The mean percentage of concussion symptoms correctly identified was 62.7%.

4.3 CONCUSSION ATTITUDES INDEX (CAI)

When identifying the symptoms of concussion in a player correctly, the important clinical implication would be to decide on the best response to the situation. The CAI mean in the JAHS group was 56.49 ± 8.81 (range 36 – 75) of a maximum score of 90 points. Participants of the JAHS group had a mean safe response of 65.6% when answering the attitude towards concussion questions. A p-value of $p > 0.98$ was noted, also showing no statistical significance between the JAHS and SAC participants' mean concussion attitude scores.

The majority (79.3%, n = 169) of this sample agreed that a concussed player must be prevented from returning to play by the coach, even if it means losing the game. Only 60% (n = 129) felt that their fellow players shared the same view. A further safe response were shown by participants towards follow-up care of a concussed player who lost consciousness as 76.5% (n = 163) of the JAHS participants agreed that a player needs to be taken to an emergency room following loss of consciousness. In Section 3.2 of Appendix A, support towards the role of the coaches were again shown as 72% (n = 154) of participants felt that coaches need to take extreme caution with RTP decisions.

The junior participants showed particular unsafe responses towards sports participation while concussed. Only 54.5% (n = 115) of participants reported that they will stop sports participation while still having symptoms that resulted from a concussion. In contrast to the support for coaches, only 66.2% (n = 141) of participants believe that a physiotherapist rather than the player himself should decide when it is safe to return to sport. Further unsafe attitudes/behaviours towards concussion were noted when play-off games are involved. Of the JAHS participants, 67.1% (n = 145) felt that a concussed player with persisting symptoms should not return to play, while only 65.6% (n = 141) felt that the same rule should apply when play-off games are involved.

Table 4.3.a Concrete statements evaluating the Concussion Attitude Index (CAI) of the JAHS and SAC groups

Statement	JAHS			SAC		
	n	% safe	% neutral	n	% safe	% neutral
I would continue playing a sport while also having a headache that results from a concussion.	211	54.5	28.9	78	55.1	26.9
I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.	214	72	21.5	78	79.5	12.8
I feel that concussions are less important that other injuries.	209	66	23	76	75	17.1
I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	209	63.2	17.7	73	68.5	21.9
I feel that an athlete who is knocked unconscious should be taken to the emergency room.	213	76.5	15	78	71.8	20.5

Table 4.3.b Scenario statements (Appendix A) contributing to the Concussion Attitude Index (CAI) of the JAHS and SAC groups

Scenario	Statement	JAHS			SAC		
		N	% safe	% neutral	n	% safe	% neutral
1	I feel that Coach A made the right decision to keep Player R out of the game	213	79.3	11.7	73	84.9	6.8
	Most athletes would feel that Coach A made the right decision to keep Player R out of the game	215	60	26	75	66.7	22.7
2	I feel that Athlete M should have returned to play during the first game of the season	216	67.1	20.4	75	65.3	20
	Most athletes would feel that Athlete M should have returned to play during the first game of the season	215	55.8	27.4	75	65.3	16
	I feel that Athlete O should have returned to play during the semi-final playoff game	215	65.6	18.6	75	61.3	26.7
	Most athletes feel that Athlete O should have returned to play during the semi-final playoff game	211	52.1	24.6	74	60.8	20.3
3	I feel that the physiotherapist rather than Athlete R should make the decision about Athlete R returning to play	213	66.2	21.1	75	53.3	30.7
	Most athletes would feel that the physiotherapist rather than Athlete R should make the decision about returning Athlete R to play	209	57.4	30	75	57.3	29.3
4	I feel that Athlete H should tell the coach about the symptoms	212	75.5	17	74	77	13.5
	Most athletes would feel that Athlete H should tell the coach about the symptoms	214	72.4	19.6	74	62.2	28.4

The CAI mean in the SAC group was 55.88 ± 11.42 (range 20 – 75) of a maximum score of 90 points. Participants of the SAC group had a mean safe response of 67% when answering the attitude towards concussion questions.

The SAC participants showed a majority safe response in particular towards coaches taking responsibility for not allowing players to RTP when concussed. Eighty five percent (n = 63) of participants agreed/strongly agreed with this notion. However only 66.7% (n = 50) of participants felt that their fellow players shared their view on coaches that may refuse a player to RTP when concussed. A further 77% (n = 57) of participants will encourage their fellow player to report concussion symptoms to their coach, even if it is only two hours before their game. Again the participants did not feel that their team mates fully agreed with them as only 62.2% (n = 49) thought other players will show the same safe response.

The most unsafe response of the senior players was towards a physiotherapist, rather than the player, making the decision of when a player can return to play following a concussion. Only 53.3% (n = 40) agreed/strongly agreed that the player should not be the one making the RTP decision. Participants also showed unsafe attitudes/behaviour towards playing while concussed. Only a fraction more than half of the SAC sample (55.1%, n = 43) reported that they will not participate in sport while having symptoms as a result of a concussion. Of the SAC participants, 65.3% (n = 49) of participants agreed/strongly agreed that a player should not return to the field when concussed during the first game of the season. However, not all of these participants felt that the same principle should be applied to play-off games, as only 61.33% (n = 46) felt that the same player should be rested when it comes to a play-off game. Further unsafe attitudes/behaviours towards RTP during play-off games were noted as 40% (n = 30) of players strongly agreed that a player should not RTP while concussed in the first game of the season while only 28% (n = 21) of players still strongly agreed when a play-off game is involved. In general, safer responses were given by the SAC participants in 67% of the questions compared to the 65.6% of the JAHS group.

Agreement among groups were seen regarding statements involving the coaches role to keep concussed players from returning to play, as 84.9% of the SAC group and 79.3% of the JAHS group showed a safe response towards this statement. However only 57.3% of the SAC group and 57.4% of the JAHS group felt that a physiotherapist rather than the player should make the RTP decision of a concussed player. Both groups showed more unsafe responses when play-off games are involved.

4.4 CONCLUSION

Reflecting on the results from the study, it was noted that both the JAHS and SAC club participants had insufficient knowledge on concussion and presented with unsafe attitudes/behaviours towards concussion and RTP. Among the two groups, no statistical significance were found on mean scores of the CKI or CAI. The next chapter will discuss the results in more depth while comparing this results to similar literature on concussion knowledge and attitudes in rugby. A discussion on the participants' demographical data will also follow and the chapter will end with reference to the limitations of the study.

CHAPTER 5
DISCUSSION

5.1 INTRODUCTION

In comparison to other collision team sports, rugby has one of the highest incidences of reported match injuries (Thompson, 2014:8). Head injury, including concussion, are the most often reported injury in professional rugby (Kaux *et al*., 2015:22). Concussion is mild traumatic brain injury (MTBI) (Harmon *et al*., 2013:15) with a high incidence noted among rugby players (Kemp *et al.,* 2008:228). Anecdotally, only a very limited proportion of amateur clubs and schools offer medical assistance next to the rugby field, and the assistance is mostly limited to matches. *BokSmart* currently leans towards educating coaches and referees to recognize concussion signs and symptoms and to remove concussed players from the field (BokSmart, 2012). However, players are often the most familiar and socially involved with their teammates and the first ones to notice any signs or symptoms among their teammates. Also, concussed players need to understand the importance of being cleared by a medical doctor before returning to full participation in rugby to avoid another concussion for which they are predisposed, and/or more serious head injuries such as second impact syndrome and CTE (Edwards & Bodle, 2014:129). Currently, no rugby safety management programme is focussing on concussion education among South African rugby players, despite watershed events such as the NFL lawsuit. As far as could be established, only a single study to date has investigated the concussion knowledge and return to play attitudes among South African rugby players (Walker, 2015:51).

This study aimed to evaluate the knowledge on concussion and attitudes/behaviours towards concussion and return to play (RTP) among South African amateur club and schoolboy rugby players, in order to motivate and inform future intervention for player education. Based on anecdotal experience and the study by Walker (2015:54), it was postulated that both amateur and schoolboy rugby players had insufficient knowledge about concussions.

5.2 DEMOGRAPHICS

5.2.1 Age

The study sample consisted of 294 South African rugby players from the Gauteng province. Players at club and high school levels were included in the study with ages ranging between 13 – 28 years old with a mean age of 16.7 years old. This was similar to Sye *et al.* (2006:1003) who studied concussion knowledge among rugby players with a mean age of 17.1 years old. The participants were divided into two groups in this study (JAHS and SAC) which allowed for data comparison between the junior and senior amateur players. As far as could be established, this was the first study including junior and senior amateur rugby players in order to compare data relating to their concussion knowledge and attitudes/behaviours. Baker *et al*. (2013:121) only focussed on under 20 rugby players while the studies of Sye *et al.* (2006:1003) turned their focus only to high school players. Walker (2015:51) who, similar to the current study, tested South African rugby players, only focussed on senior-level rugby players. O'Connell and Molloy (2016:523) also studied a more senior rugby playing population, with ages ranging from 18 – 31 years old. However they included male and female rugby players which was in contrast to the current study with only male rugby players. Boffano *et al*. (2011:2053) studied a similar population age group of 13 – 39 year old rugby players compared to the 13 – 28 year old players included in the current study. However, Boffano *et al*. (2011:2053) made no attempt to compare data of junior and senior player and reported their findings based on the population as one group.

The JAHS group included 216 participants and largely consisted of under 16 players forming 56.94% of the JAHS sample. At the time of data collection the public schools' grade 12 scholars were busy writing exams. These students were only required to attend school during the time when an exam was due. This resulted in less under 18 level players included in the JAHS group, due to the lack of availability of players for testing. Further, 68% of the SAC group (which included 72 participants) consisted of under 21 level players. Considering the fact that the questionnaires were completed at practice sessions, the higher number of under 21 level players included in the SAC group may possibly be attributed to the logistical challenges to attend practice sessions associated with full time employment of more senior players. The sample group was similar to the population that Walker (2015:51) investigated, namely 127 amateur South African rugby players. However as previously mentioned, Walker (2015:51) only studied players at senior club level where this study also included high school players. The hypothesis would be that high school players would present with decreased knowledge on concussion, due to less years of rugby playing exposure and a lower level of

participation. Considering the similarities in age between the SAC participants from this study and that of Walker (2015:51), it was expected that some similarities would also occur in the findings from the study compared to that of Walker (2015:51).

5.2.2 Sample size

In this study 294 participants were included, compared to the 127 participants of Walker (2015:51). The current study also included a larger number of participants compared to other international studies evaluating concussion knowledge and attitudes/behaviours among rugby players. A total number of 133 participants completed questionnaires in the study of Baker *et al*. (2013:121), 79 participants in the study of O'Connell and Molloy (2016:523) and 65 participants in the study of Boffano *et al*. (2011:2053). Sye *et al*. (2006:1003) studied New Zealand high school rugby players and was the only study with a larger number of participants (n = 477). This highlights the fact that the sample size for this study were considerably higher compared to similar studies from literature.

5.2.3 Player position

Smaller studies would make classification according to player position difficult, due to the variety of player positions. In this study sample of 294 amateur rugby players, the front row positional group was the most represented followed by the back-three and loose forward groups (Dawson, 2016). Each three of these positional groups included three individual positions. Positional groups such as the second row and centres only included two specific positions followed by the scrum-half and fly-half groups that consisted of a single specific position. The scrum-half and fly-half positional groups had the least amount of participants potentially due to single positional make-up of these positional groups. This was also most likely why in the current study the groups with the more inclusive individual player positions such as the front row and back-three, had a higher proportional representation of participants. Among the JAHS group the highest number of participants were front row players (n = 56) forming 25.9% of the JAHS participants. This was different from the SAC group where the back-three positional group had the largest number of participants (n = 21) forming 26.9% of the SAC participants. These findings agree with the fact that positional groups with a larger individual positional inclusion had an increased potential for a higher number of included participants. The contrast seen between the JAHS and SAC groups' positional representation could not be attributed to a single factor since all player positions had an equal chance of participation among the players. Therefore, the differences seen in proportional

representation of the different player position groups of the JAHS and SAC groups merely reflected the availability of participants that were available on the day of testing.

5.2.4 Body mass

Considering the fact that forward rugby players need higher body compositions, it is clear that player positions reflected in the body masses of the participants (Pumpa *et al.,* 2012:119). A marked lower mean player mass of 76.9 kg (± 15.9 kg) was seen in the JAHS group compared to the mean player mass of 86.8 kg (± 17.6 kg) seen in the SAC group. This was expected as the JAHS group consisted of mainly of younger high school boys typically in growing phases at under 16 (56.9%, n = 123) and under 14 (24.5%, n = 53) levels. Further the SAC participants were expected to be less active as less physical activity are reported among adults compared to children (Ball & Bice, 2015:144). Despite the lower mean body mass of the JAHS group, it was interesting to note that 21.3% (n=46) of JAHS players already weighed 90 kg or more. This could have been due to the substantial number of front row players included in the JAHS group as this positional group usually consists of players with a larger body mass. Forward (front row, second row, lose forward) rugby players will present with a higher body mass as their positions require strength and power to compete at rucks, mauls and scrums (Pumpa *et al.*, 2012:119) While backs (scrum-half, fly-half, centres, back-three) require more speed and agility resulting in lower body masses noted among these player positions (Pumpa *et al*., 2012:119).

5.2.5 Player experience

The same tendency regarding the difference in age when related to body mass, could also be expected in the findings regarding the amount of experience. In general, the participants were well experienced in terms of years rugby playing experience. The SAC group had a higher median of ten ($Q_1 = 6$; $Q_3 = 15$) years rugby playing experience compared to the eight years ($Q_1 = 7$; $Q_3 = 10$) seen among the JAHS group. Considering the difference in age between the two groups, one would expect a larger median difference in years of playing experience. Further it was expected that senior players of the SAC group would have a higher number of players with five years or more experience compared to the junior players of the JAHS group. However anecdotally, players often start playing rugby later in their school careers and therefore participate at senior club without extensive playing experience. Also, due to the larger number of under 21 level players in the SAC group, the age difference between the JAHS and SAC groups were limited which carried over into the years of playing experience

as well. This was especially evident in the marginal difference of players with five or more years of rugby playing experience between the two groups; the majority (89%) of the JAHS participants had at least five years or more rugby playing experience while 81.8% of the SAC participants fell in the same category.

5.2.6 Concussion histories

Many authors considered player positions to be a potential risk factor for sustaining a concussion (Gardner *et al.,* 2014:1722). From the 71 JAHS participants with a history of concussion and player position information available, 43.8% (n = 14) were second row players. The JAHS second row positional group also had the highest number of reported concussions among players that sustained a previous concussion. It was interesting to note that among the SAC participants, the second row positional group also showed the highest percentage with 66.7% (n = 6) of the second row participants reported sustaining a previous concussion. These findings are in contrast to self-reported concussion incidences among under 21 level Irish rugby players which showed the loose forward positional group to have the highest incidence on concussions followed by the front row and centre groups (Fraas *et al*., 2014:138). A particular high percentage (64.3%, n = 9) of the SAC centre positional group in the current study sustained a previous concussion. This is in line with Fraas *et al*. (2014:138) who also noted a high incidence of concussion among the centre positional group. The centre and back-three positional groups run at high speeds into contact situations compared to forward players that are more often involved in wrestling-type activity and taking contact and less velocity (Dawson, 2016). A systematic review on concussions in rugby reported that four out of six studies showed that forward players had a lower incidence of concussion compared to backs, although these results were not statistically significant (Gardner *et al*., 2014:1722).

The lowest number of reported concussions in both the JAHS and SAC groups were among the fly-half positional group. In the JAHS fly-half positional group 25% (n = 3) of participants sustained a previous concussion while only 16.7% (n = 1) of SAC fly-half participants sustained a previous concussion. A fly-half is the first-receiver of the ball from set pieces (scrums and lineouts) and most commonly the main decision maker on the field. This player position is less involved in contact situation on defence and more involved in distribution or kicking of the ball on attack (Dawson, 2016). Therefore the small number of reported concussions among this specific player positional group could be expected.

Participants' self-reported concussion incidence were shown to be higher among players with more years of playing experience. Considering the increased exposure to possible contact

injuries with an increase in years of playing rugby, this was expected as an increased number of playing years would most likely relate to an increased number of concussions. Among the SAC group, 45.1% (n = 32) of participants reported having sustained a concussion, compared to 32.9% (n = 72) of JAHS group's participants. Even though the self-reported concussion incidence of 32.9% among the JAHS participants are similar to O'Connell and Molloy (2016:524), no direct comparison could be done as different age groups were studied. The current results were in contrast to a study done on South African rugby players between 2002 and 2006 (Shuttleworth-Edwards *et al*., 2008). Even though Shuttleworth-Edwards *et al*. (2008:406) agreed that the concussion incidence at adult level was higher compared to high school level, they showed a smaller percentage of concussion incidences. Their senior level concussion incidence ranged between 3% and 23%, while school level players had an incidence of between 4% and 14%. This might be attributed to the lack of medical attention at the amateur levels resulting in less reported concussions. The same principle applied to their school level rugby group where the private schools showed a higher incidence of reported concussion than the government schools. At private schools there are a milieu of more individual attention leading to increased reported concussions (Shuttleworth-Edwards *et al*., 2008:407). The author further states that the specific study was not designed to definitely record concussion incidence (Shuttleworth-Edwards *et al*., 2008:408). The current study only included government schools and amateur clubs and still the concussion incidences are higher compared to the findings of Shuttleworth-Edwards *et al*. (2008:406). The fact that the current study only relied on the participant to declare if he had previously been concussed, could have resulted in the large difference seen between the two studies. Players could have presented with a misconception of concussion and therefore falsely reported a concussion leading to over-reporting or not declaring a concussion leading to under-reporting.

The more years of playing experience may expose a player to higher risk of sustaining a concussion. As stated by Kemp *et al.* (2008:229), concussion incidence is higher during match play compared to training. This could be the reason why in the current study the SAC group with more years of playing experience had a higher incidence of concussion. However, this was a self-reported measure of concussion incidence and therefore under/over reporting due to lack of knowledge on concussion could have also played a role. The SAC group had a higher median of years rugby playing experience resulting in an increased likelihood of being exposed to concussion and concussion management protocols where knowledge could be gained.

5.3 CONCUSSION INFORMATION RECEIVED

In total only 45.87% of the study sample had previously received information on concussion, which is marginally more than the 38.5% informed participants reported in Boffano *et al*. (2011:2053). A better informed sample were noted in Sye *et al*. (2006:1003) who reported that 61% of their participants have previously been informed on concussion. Only 41.40% of the JAHS participants had previously received information on concussion compared to the 58.67% of SAC participants. This again correlates with that fact that the SAC participants had a higher reported incidence of concussion and player years, and most likely been exposed to concussion management where players were informed. Walker (2015:53) reported that players who sustained a previous concussion more often provided correct answers on concussion knowledge questions compared to players with no history of concussion. However, this was not a significant difference.

Participants received information on concussion from various sources. Health care professionals (medical doctor, physiotherapist and nurse) played the biggest role as source of information as indicated by the 42.2% of the study sample who reported it as their source of knowledge. The JAHS group specifically received the majority of information from health care professionals as 47.2% of participants gained information via this source. This is in concordance with Boffano *et al*. (2011:2054) who also reported a healthcare worker as the main source of concussion information to their sample. O'Connell and Molloy (2016:524) however showed that teammates were the main source of information to concussion. This further emphasise the need for concussion education among rugby players.

The SAC participants in the current study gained their majority of information at the previous school they attended. This might seem contradictory to the findings in school players who mostly received their information from health care professionals. It can be hypothesised that school players might more likely be exposed to health care professionals following a concussion as parents will take responsibility for their child's health and well-being. Therefore health care professionals will be their likely source of concussion information. The fact that SAC players reported their previous school as the most common source of information, might again emphasise the importance of concussion education at high school level. This is similar to Boffano *et al*. (2011:2054) who reported the school/university as the second most common source of information on concussion. However, they also included university as part of the school category where the current study focussed on schools as a separate category.

Coaches did not play a major role in informing players as only 6.7% of the SAC participants and 13.9% of the JAHS participants reported coaches as their source of information on concussion. As *BokSmart* focus on educating coaches and referees on concussion (BokSmart, 2012), it was expected that coaches would have been a more common source of concussion information to players. Considering the fact that teachers often fulfil the role of rugby coaches as well, it could have been misleading as some participants at school level reported their teacher as a source of concussion information. However this could not have been a problem among the SAC participants where only 6.7% of participants reported their coach as source of concussion information, implying that the coaches potentially was indeed not a noteworthy source of information among rugby players. A source that was expected to have larger influence concussion awareness than coaches, was the media. However, similar to Boffano *et al.* (2011:2054) the media played a very small role as a source of concussion information. This is definitely an area for investigation as it is one of the largest platforms for communication (Fourie, 2015:1). Social media especially are widely used as information source among all ages (Fourie, 2015:129). The seriousness of concussion as an injury warrant further effort to use the media as tool to inform the public and players on concussion.

5.4 CONCUSSION KNOWLEDGE

The CKI which had a mean value of 10.46 ± 2.36 (range 3 – 15) of a maximum of 17 points in the JAHS group, compared to the mean of 10.17 ± 2.35 (range 4 – 14) in the SAC group. Participants of the JAHS group on average identified 62.4% of the knowledge questions correctly while the SAC group had a similar average of 60.2%. As noted in Figure 4.6.b, 58.7% of the SAC participants previously received information about concussion. Therefore, in the SAC group the percentage informed participants was closely related to the mean percentage of correctly answered CKI questions. Among the JAHS group no direct relation was noted. They managed to obtain a mean of 62.4% of the CKI answers correct, even though only 41.3% of them had previously received information on concussion.

Certain questions of the CKI were answered correctly by a high percentage of participants. The fact that a single concussion does not affect an individual's intelligence was answered correctly by 86% (n = 184) of the JAHS group and 93.6% (n = 73) of SAC group. Socially, there is an assumption that less intelligence are related to poor education and lower social hierarchy (Rose, 2009:2). Irrespective of the misconception about intelligence among society (Rose, 2009:2), intelligence is still valued among society. This may have been a strong

motivator for the high percentage of correct answers seen on this question as intelligence are valued most likely won't expose themselves to sport where the can potentially lose intelligence. Participants understood the potential risk of death when sustaining a concussion while already concussed, as 81.7% of JAHS participants and 76.7% of SAC participants answered this question correctly. The fact that a concussed player can take several weeks before fully recovered was correctly identified by 80.3% of the JAHS group and 80% of the SAC group. This finding was similar to Baker *et al*. (2013:124) who reported that players indicated that at least three weeks of rest are required before RTP.

The fact that a player do not have to lose consciousness to be diagnosed with a concussion were correctly identified by 79% of JAHS participants and 73.7% of the SAC participants (Table 4.1.a). This is considerably higher than O'Connell and Molloy (2016:524) who reported that only 60.5% of their participants identified this correctly. Walker (2015:52) reported that 87% of participants knew that a player's potential for sustaining a concussion increases if he has a history of a previous concussion; only 65.6% of the JAHS participants and 48.1% of the SAC group were aware of this fact. This could be due to the fact that Walker (2015:51) studied a sample with more rugby playing experience and exposure to provincial level rugby where concussion management protocols are in place. Considering the differences in rugby playing experience and level of play between the participants from this study and that of Walker (2015:51), the discrepancy in knowledge between professional and amateur rugby players imply that there is a better chance of a player being exposed to concussion information at provincial level compared to club level or high school level where minimal medical assistance is available.

The most common misconception among participants of both groups were that a concussion can be identified via brain imaging, showing physical brain damage (Table 4.1.a). Only 23.3% (n = 50) participants of the JAHS group and 18.7% (n=14) of the SAC group answered this question correctly. O'Connell and Molloy (2016:523) also highlighted this misconception, however a larger percentage of 43.4% of participants were able to identify this answer correctly compared to the participants from this study. Even though a high percentage of incorrect answers were seen for this question among the participants of this study, the implication thereof may not be of major concern as patients cannot refer themselves for brain imaging and their misconception would not affect their decision-making on RTP. In South Africa, only a medical doctor can decide to refer a patient for brain imaging. Therefore a medical doctor will be able to inform the player that even though the brain image shows no physical brain damage, a concussion cannot be excluded. However, Jansen Van Rensburg (2013:90) reported that medical doctors were not aware of the risks involved, when allowing

a child to return to full participation to soon following a concussion. Neurophysiological testing's importance, was also not recognised in RTP decision making among medical doctors (Jansen Van Rensburg, 2013:90). This further emphasised the importance of medical doctors that need to be informed on concussion management and RTP.

Returning to full rugby participation prematurely may lead to an increased risk of second impact syndrome (SIS), which can be fatal (Edwards & Bodle, 2014:129). The increased risk of multiple concussions affecting a player's long-term health and well-being were incorrectly answered as "false" by a large number of JAHS participants (n=145, 67.8%). This is in contrast to the scenario identified correctly by the second largest part of the sample (81.9%, n = 176). This scenario stated that the long-term health and well-being of a player who sustained four concussions will be affected (Appendix A, Section 2.2). The difference in question construct could be postulated to have had an effect on these findings. The question answered incorrectly (Appendix A, Section 1.18) were just a statement, while the question participants answered correctly (Appendix A, Section 2.2) was a scenario where the participant could compare two different players, one sustaining a single concussion and the other four concussion. This scenario gave the participant insight to a more practical application of the statement which most likely led to the majority of participants correctly answering section 2.2. These two questions (Appendix A, Section 1.18 and 2.2) were answered more consistently among SAC group participants. Section 1.18 (Appendix A), which was a statement, were answered correctly by 53.25% (n=41) of the SAC participants compared to 32.24% (n=69) of the JAHS group. Section 2.2, which gave more insight into the question through creating a practical scenario, were answered correctly 66.67% (n=52) of the SAC participants. Therefore, among both groups the scenario created gave them more insight to the question. These findings could be attributed to a learning strategy namely, authentic learning. Authentic learning describes problems in real-world scenarios, promoting active participation from participants (Ma & Lee, 2012:273). Through creating real-world scenarios, participants are allowed to create a more personal connection with the educational material (Ma and Lee, 2012:274). Therefore the scenario (Appendix A, Section 2.2) which created a real-world scenario, which could have led to the higher percentage of correct answers. The reason for the large difference between the percentage of correct answers in JAHS group when compared to SAC group is potentially due to the inferior deductive-reasoning abilities of younger children compared to older men.

Another misconception on concussion was that only 37.3% of JAHS participants and 42.9% of SAC participants knew that a concussion can be sustained via a hit anywhere on the body, and not only on the head. These results were similar to O'Connell and Molloy (2016:523) who

reported that only 47.4% of their study sample where able to correctly identify head impact not being the only reason for sustaining a concussion. This further motivates for education among rugby players in order to identify concussion symptoms among teammates, even though no clear hit to the head was noticed.

5.5 CONCUSSION SYMPTOM IDENTIFICATION

Participants of the JAHS group on average identified the symptoms of concussion correctly 66.3% of the time. The non-concussion symptoms, were correctly left out at a higher mean percentage of 73.8%, however this could be either due to correct non-identification of a non-concussion symptom or due to a missed answer not filled in by the participant. Section 5 of the questionnaire only provided for identification by a single ticking a box next to the symptom. Therefore a box that is not ticked could mean either that the participant do not agree that it is a symptom of concussion or it can be due to a missed answer. Therefore more focus was placed on correctly identified results. This factor could potentially gave the higher mean percentage of non-concussion items identified correctly. The mean percentage of concussion symptoms correctly identified by SAC participants were 62.7%. The mean percentage of non-concussion symptoms identified was higher at 72.4%. However, as discussed before, this could be a false reflection as potential missed answers will fall under this mean percentage.

Among the JAHS and SAC participants, headache was the most common correctly identified concussion symptom. This was in contrast to the results of Boffano *et al*. (2011:2054) who reported headaches as the sixth most commonly identified concussion symptom. They reported symptoms of nausea, vomiting, memory loss, dizziness and loss of consciousness as symptoms more frequently identified by Italian rugby players (Boffano *et al*., 2011:2054). Dizziness was also frequently identified correctly in the current study with 83.8% of JAHS participants and 70.5% of SAC participants providing correct identification. In contrast to Boffano *et al*. (2011:2054) the current study showed a low rate of correct identification of memory loss as a symptom of concussion. Only 57.7% of SAC participants were able to correctly identify this symptom.

An interesting finding on the theme of loss of consciousness was noted. In the CKI a large percentage of participants (JAHS = 79%, SAC = 73.7%) knew that a player did not need to lose consciousness in order to be diagnosed with a concussion. However, this knowledge might have created a misconception among participants as only 47.2% of JAHS participants

and 56.4% of SAC participants were later able to identify loss of consciousness as an actual symptom of concussion. Emphasis needs to be placed on the fact that loss of consciousness is not needed in order to be diagnosed with a concussion, however if this symptom occurs a concussion will most likely be present.

5.6 ATTITUDES/BEHAVIOURS TOWARDS CONCUSSION

It was interesting to note that even though the JAHS participants had better concussion knowledge, they had more unsafe attitudes/behaviours towards concussion and RTP compared to the SAC participants. The CAI mean in the JAHS group was 56.49 ± 8.81 (range 36 – 75) of a maximum score of 90 points. Participants of the JAHS group had a mean safe response of 65.6% when answering the attitude/behaviour regarding concussion questions. The CAI mean for correct answered questions in the SAC group was 55.88 ± 11.42 (range 20 – 75) of a maximum score of 90 points. Participants of the JAHS group had a mean safe response of 65.6% when answering the attitude towards concussion questions while the SAC group had a mean safe response of 67%. This finding was supported by Kroshus *et al.* (2015a:245) who criticised the use of increased concussion knowledge as a predictor of the effectiveness of concussion educational tools. They argued that concussion knowledge only indicates if the individual paid attention to the given information, but not if it will improve reporting behaviours in-season (Kroshus *et al.,* 2015a:245). In order to obtain effective behavioural change Kroshus *et al.* (2015a:246) proposed adding real life simulation to educational programs in order to help individuals make safe decisions. This is in line with the view of Kurowski *et al*. (2014:15) who stated that improved self-report behaviours were not associated with previous concussion education or better knowledge on concussion.

Under certain themes of concussion, participants showed safer attitudes/behaviours towards concussion and RTP. The majority (79.3%, n=169) of the JAHS participants agreed that a concussed player must be prevented from returning to play by the coach, even if it implied losing the game. A further 11.7% of participants showed a neutral response. These players specifically could benefit from concussion education as they did not have a set opinion yet on the theme. In this specific instance, the participants who showed a neutral response could potentially be influenced positively with concussion educational programs, improving the safe response percentage to 91%. Among the SAC participants 84.9% (n=63) shared the same safe response towards coaches preventing concussed players from full participation. A further 6.8% of SAC participants showed a neutral response to this theme. A further safe response were shown by participants towards follow-up care of a concussed player who lost

consciousness as 76.5% (n = 163) of the JAHS and 71.8% (n = 78) of the SAC participants agreed that a player needed to be taken to an emergency room following loss of consciousness. On this theme 15% of JAHS participants and 20.5% of SAC participants showed neutral responses, emphasising the need as discussed before of concussion education among rugby players. Even though players with neutral responses could potentially be positively influenced by concussion educational programmes, the players with unsafe responses should not be discarded. Concussion education should specifically target the players with unsafe responses as they are risking their own health. The fact that the majority of players showed safe responses towards follow-up care of a concussed player who lost consciousness were in contrast to the results reported in the CKI. Only 47.2% of JAHS participants and 56.4% of SAC participants were able to identify loss of consciousness as an actual symptom of concussion, but still they showed a majority safe response towards a player who lost consciousness. This could have been attributed to a more safe response towards an unconscious player compared to a concussed player.

The JAHS and SAC participants showed particular unsafe responses towards sports participation while concussed. Only 54.5% (n=115) of JAHS participants and (55.1%, n=43) of the SAC participants reported that they will stop sports participation while still having symptoms that resulted from a concussion. This is alarming as previously in the CKI the majority of participants (JAHS = 81.7%, SAC = 76.7%) indicated that they understood the potential risk of death when sustaining a second concussion while already concussed. This could be due to a possible misconception among players on whether the presence of concussion symptoms actually indicates a full diagnosis of concussion. Again this emphasise the need for concussion education among players in order to eliminate misconceptions and promote safer attitudes/behaviours towards concussion and RTP.

Further unsafe attitudes were seen regarding the RTP decision making following a concussion. It raised concern to see that only 66.2% (n=141) of JAHS participants and 53.3% (n=40) of SAC participants believed that a physiotherapist, rather than the player himself, should decide on when it is safe for the concussed player to return to full participation. This was in concordance with Baker *et al*. (2013:124) who reported that only 66% of their participants believed that a doctor should have the final say on when a player can RTP. Sye *et al*. (2006:1003) reported more alarming results, as only 30% of participants that reported a concussion, indicated that they waited to be cleared by a doctor before RTP.

A tendency towards more unsafe behaviour was seen when the player needed to be involved in a play-off game. Of the SAC participants, 65.3% (n=49) agreed/strongly agreed that a player

should not return to the field when concussed during the first game of the season. However, not all of these participants felt that the same principle should be applied to play-off games, as only 61.33% (n=46) felt that the same player should be rested when it comes to a play-off game. An even stronger tendency towards unsafe attitudes/behaviours during play-off games were seen among the SAC participants. In their group 40% (n=30) of players strongly agreed that a player should not RTP while concussed in the first game of the season while only 28% (n=21) of players still strongly agreed when a play-off game was involved. O'Connell and Molloy (2016:524) showed similar unsafe attitudes as 75% of their participants reported that they would continue to play with a concussion in important games. This is concerning as a player's health and potential life, should be more important than a rugby game. O'Connell and Molloy (2016:524) who interviewed rugby players, reported that players showed these unsafe behaviours as they did not want to let the team down. Contrary to these findings Sye *et al*. (2006:1003) reported only 27% of participants felt that a player should play in an important game, even if concussed.

5.7 LIMITATIONS

Although specific measures were taken to limit methodological errors (see Section 3.7.2), certain limitations were identified during the course of the study which have to be taken into account when interpreting the findings.

Sample size and sample selection were affected by the time of year the data was collected. At the time of data collection the public schools' grade 12 scholars were busy writing exams. These students were only required to attend school during the time when an exam was due. This resulted in less under 18 level players included in the JAHS group, due to the lack of availability of players for testing. At amateur club level, most senior players have full time occupations and are less frequently able to attend practice sessions due to work commitment. Considering the fact that the questionnaires were completed at practice sessions, the higher number of under 21 level players included in the SAC group may possibly be attributed to the logistical challenges to attend practice sessions associated with full time employment. The composition of the sample may therefore have threatened the internal validity to a certain degree, as well as the generalisability of the findings.

Further challenges were experienced at school level it was not feasible to evaluate all participants simultaneously, as each age level trained at different times and had different academic rosters. The study was explained to the respective schools' rugby organisers. Exact

guidance was given to the participants in order to explain the study to them and be able to answer any questions the participants may have regarding the questionnaire. Even though exact guidance was given, no record was kept on exact answers that the respective rugby organisers gave participants on questions they had regarding the questionnaire. Unsystematic errors could therefore have threatened the reliability of the measuring instrument.

A two week period was given for data collection at school level. Participants could therefore potentially have communicate with other participants affecting their knowledge on concussion and contaminating some of the findings. This was seen were the JAHS group obtained a mean of 62.4% of the CKI answers correct, even though only 41.3% of them had previously received information on concussion. Considering the possibility of contamination, participants may have come to know what the experiment was about and accordingly have changed their behaviour to what they might thought was expected of them. In any research the possibility of the Hawthorne effect and sensitisation to the experimental conditions must be considered, even in the absence of contamination.

The above limitations must therefore be considered when concluding on the findings of this study and suggesting recommendations. The next chapter concludes the discussion and this report by integrating the findings into recommendations and a summary answering the research question.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Within the limitations of this descriptive study, it was concluded that both junior and senior South African amateur rugby players seemed to have insufficient knowledge on concussion. The junior amateur high school (JAHS) players answered only 62.4% of the Concussion Knowledge Index (CKI) questions correctly. The senior amateur club (SAC) players showed similar insufficient knowledge on concussion as the players answered only 60.2% of the questions correctly. No statistical significance were found between their mean concussion knowledge scores ($p > 0.37$). Both the JAHS and SAC groups had misconceptions about concussion under similar themes. The fact that a concussion cannot be diagnosed via brain imaging was the most common misconception. Most of the participants incorrectly believed that a concussion can only be sustained via a direct hit to the head and that multiple concussions cannot have an effect on their long-term health and well-being.

The participants' lack of concussion knowledge were further emphasised during concussion symptom identification. It was concluded that both junior and senior South African amateur rugby players had insufficient knowledge on what symptoms are associated with concussion. On average the JAHS participants only identified 66.3% of concussion symptoms correctly, while the SAC participants only identified 62.7% correctly.

Within the limitations of this study, it seemed that both junior and senior South African amateur rugby players showed unsafe attitudes/behaviours towards concussion and RTP. Among the JAHS participants, a mean percentage of only 65.6% safe responses were noted on the Concussion Attitudes Index (CAI) questions. The SAC participants showed a mean of only 67% safe responses. No statistical significance between the JAHS and SAC participants' mean concussion attitude scores were noted ($p > 0.98$). A particular high percentage of unsafe responses among both JAHS and SAC participants were noted towards participating in sport, even while presenting with concussion symptoms. Both groups showed a high percentage of unsafe responses towards RTP decision-making following a concussion. Only 66.2% of JAHS participants and 53.3% of SAC participants felt that a physiotherapist, rather than the player, should decide whether the player is safe to RTP. These unsafe responses where even more evident during pressure situations as participants showed higher unsafe responses towards RTP when play-off games are involved.

The aims of this study were to evaluate the knowledge on concussion and attitudes/behaviours towards concussion and RTP of South African amateur high school and club rugby players in order to motivate and inform future intervention for player education. The findings of this study implicates that junior and senior South African amateur rugby players may have insufficient knowledge on concussion and presents with unsafe attitudes/behaviours towards concussion and RTP. This provides motivation for further implementation of concussion educational programmes among amateur South African rugby players.

6.2 RECOMMENDATIONS

Future research should focus on incorporating other geographical regions of South Africa in order to improve generalisability of the findings and to have a more comprehensive understanding of South African rugby players' concussion knowledge and attitudes/behaviours towards concussion and RTP. The focus should also move to identifying specific rugby playing populations with insufficient knowledge on concussion injuries in order to implement population-specific concussion education programmes.

Within South Africa there are active rugby playing populations in rural regions. These players may have a lack of knowledge on concussion due to less exposure to on-field medical assistance. In order to study rural populations, future research should aim to translate and validate the modified RoCKAS-ST in the 11 official languages of South Africa. This will allow participants who do not understand English also to be evaluated on concussion knowledge.

This study should therefore be seen as a baseline study upon which further research should emanate.

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APPENDICES

Appendix A: Modified Rosenbaum Concussion Knowledge and Attitudes Survey – Student Version (RoCKAS-ST) with scoring key

	SECTION 1		
	Please read the following statements and circle TRUE or FALSE for each question.		
1	There is a possible risk of death if a second concussion occurs before the first one has healed	TRUE	FALSE
2	Running everyday does little to improve cardiovascular health	TRUE	FALSE
3	People who had one concussions are more likely to have another concussion	TRUE	FALSE
4	Studs help athlete's 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 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 (CAT scan, MRI, X-ray etc.) typically shows visible physical damage (bruise, blood clot) to the brain	TRUE	FALSE
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	Grade eight high school students and first year university students tend to be the same age.	TRUE	FALSE
16	Concussions can sometimes lead to emotional disruptions	TRUE	FALSE
17	An athlete 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		
	Please read each of 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 long-term health and well-being.	TRUE	FALSE
2	It is likely that player X's concussion will affect his long term-health and well-being.	TRUE	FALSE
	Scenario 2: *Player F suffered a concussion in a game. He continued to play in the game despite the fact that he continued to feel the effects of the concussion.*		
3	Even though player F is still experiencing the effects of the concussion, his performance will be the same as when he had not suffered a concussion.	TRUE	FALSE

	SECTION 3					
	For each question, circle the number that best describes how you feel about each statement.	Strongly disagree	Disagree	Neutral	Agree	Strong agree
1	I would continue playing a sport while also having a headache that results from a concussion	1	2	3	4	5
2	I feel that coaches need to be extremely cautious when determining whether an athlete should return to play	1	2	3	4	5
3	I feel that mouth guards protect teeth from being damaged or knocked out	1	2	3	4	5
4	I feel that professional athletes are more skilled at their sport than high school athletes	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 athletes 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 an athletes who is knocked unconscious should be taken to the emergency room	1	2	3	4	5
8	I feel that most high-school athletes will play professional sports in the future.	1	2	3	4	5

	SECTION 4					
	For each question, read the scenarios and circle the number that best describes your view. (For the questions that ask you what most athletes feel, best your answer on how you think MOST athletes 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 athletes 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 semifinal playoff game. Both athletes had persisting symptoms.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3	I feel that Athlete M should have returned to play during the first game of the season (that same game of the injury)	1	2	3	4	5
4	Most athletes would feel that Athlete M should have returned to play during the first game of the season (that same game of the injury)	1	2	3	4	5
5	I feel that Athlete O should have returned to play during the semifinal playoff game	1	2	3	4	5
6	Most athletes feel that Athlete O should have returned to play during the semifinal playoff game	1	2	3	4	5
	Scenario 3:					
	Athlete R suffered a concussion. Athlete R's team has a physiotherapist on staff.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
7	I feel that the physiotherapist rather than Athlete R should make the decision about Athlete R returning to play.	1	2	3	4	5
8	Most athletes would feel that the physiotherapist rather than Athlete R should make the decision about returning Athlete R to play	1	2	3	4	5
	Scenario 4:					
	Athlete H suffered a concussion and has a game in two hours. He is still experiencing symptoms of a concussion. However,athlete H knows that if he tells his coach about the symptoms, his coach will keep him out of the game.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
9	I feel that Athlete H should tell coach about the symptoms	1	2	3	4	5
10	Most athletes would feel that Athlete H should tell coach about the symptoms	1	2	3	4	5

	SECTION 5	
	Think about someone who has had a concussion. Identify the following signs and symptoms that you believe someone make be likely to experience after the concussion. Tick the box on the left side	
	Abnormal sense of smell	
	Abnormal sense of taste	
	Amnesia (memory loss)	
	Blurred vision	
	Black Eye	
	Chest Pain	
	Confusion	
	Dizziness	
	Headache	
	Loss of consciousness	
	Nausea	
	Nosebleed	
	Numbness/Tingling in upper extremity	
	Sharp burning pain in the neck	
	Sleep disturbances	
	Weakness of neck range of motion	

Scoring key for RoCKAS-ST

Section												
1			*2*			*3*			*4*		
Item	*Correct Response*	*Index*[a]	*Item*	*Correct Response*	*Index*	*Item*	*"Safer" Response*[b]	*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									

Correct Symptoms in bold:

Abnormal sense of smell	Abnormal sense of taste
Amnesia	**Blurred Vision**
Black eye	Chest Pain
Confusion	**Dizziness**
Headache	**Loss of consciousness**
Nausea	Nosebleed
Numbness/tingling in the upper extremity	Sharp burning pain in the neck
Sleep disturbances	Weakness of neck range of motion

Appendix B: Ethical clearance letter from the University of the Free State (UFS)

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

IRB nr 00006240
REC Reference nr 230408-011
IORG0005187
FWA00012784

18 June 2015

MR CT VILJOEN
DEPARTMENT OF PHYSIOTHERAPY
UFS
BLOEMFONTEIN

Dear Mr CT Viljoen

ECUFS NR 105/2015
DEPARTMENT OF PHYSIOTHERAPY
PROJECT TITLE: CONCUSSION KNOWLEDGE AMONG SOUTH AFRICAN RUGBY PLAYERS.

1. You are hereby kindly informed that the Ethics Committee approved the study after all conditions have been met and the decision will be ratified at the meeting scheduled for 21 July 2015.

2. Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

3. A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.

4. Kindly use the ECUFS NR as reference in correspondence to the Ethics Committee Secretariat.

5. The Ethics Committee functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite).

Yours faithfully

.....
DR SM LE GRANGE
CHAIR: ETHICS COMMITTEE

Cc: Ms C Brandt

Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | F: +27 (0)51 444 4359 | E: ethicsfhs@ufs.ac.za
Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa
www.ufs.ac.za

Appendix C: Approval letter from the South African Rugby Union (SARU)

SOUTH AFRICAN RUGBY UNION
SARU House | Tygerberg Park | 163 Uys Krige Drive | Plattekloof | Cape Town 7500
P.O. Box 15929 | Panorama 7506
Tel: +27 (0)21 928 7000 | www.sarugby.co.za
: springboks | : @bokrugby

10 June 2015

Dear Carel

Your research proposal and request were discussed by the SARU Internal Research Review Committee. Please note the following:

1. We are comfortable that you proceed with your research project: "CONCUSSION KNOWLEDGE AMONG SOUTH AFRICAN RUGBY PLAYERS".

2. SARU encourages all provincial rugby unions that are approached to participate in the study to please consider getting involved in the study and to contribute in a meaningful way.

3. Unfortunately we cannot force any of the provincial unions to participate if they are not willing to do so.

4. Please note that SARU does not provide any financial assistance.

Thank you once again for your interest in the game of rugby.

Regards

I. Jakoet

Dr Jakoet

Appendix D: Approval letter from the Gauteng Department of Education (GDE)

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: D2016 / 111
enquiries: Diane Buntting 011 843 6503

GDE RESEARCH APPROVAL LETTER

Date:	**8 June 2015**
Validity of Research Approval:	**8 June 2015 to 2 October 2015**
Name of Researcher:	**Viljoen C.T.**
Address of Researcher:	**111 Dadelboom Street; Zwartkop; Centurion; 0157**
Telephone / Fax Number/s:	**084 511 9226**
Email address:	**viljoen.ct@gmail.com**
Research Topic:	**Concussion knowledge among South African rugby players**
Number and type of schools:	**THIRTY-THREE Secondary Schools**
District/s/HO	**All Districts**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved. A separate copy of this letter must be presented to the Principal, SGB and the relevant District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted. However participation is VOLUNTARY.

The following conditions apply to GDE research. The researcher has agreed to and may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

CONDITIONS FOR CONDUCTING RESEARCH IN GDE

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter;
2. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB);

2015/06/07

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

3. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned;
4. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, SGBs, teachers and learners involved. Participation is voluntary and additional remuneration will not be paid;
5. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal and/or Director must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage;
6. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year;
7. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
8. It is the researcher's responsibility to obtain written parental consent and learner;
9. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources;
10. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations;
11. On completion of the study the researcher must supply the Director: Education Research and Knowledge Management with one Hard Cover, an electronic copy and a Research Summary of the completed Research Report;
12. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned; and
13. Should the researcher have been involved with research at a school and/or a district/head office level, the Director and school concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Dr David Makhado

Director: Education Research and Knowledge Management

DATE: 2015/06/07

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

Appendix E: Participant information sheet

Research title: CONCUSSION KNOWLEDGE AMONG SOUTH AFRICAN RUGBY PLAYERS

I, Carel Thomas Viljoen, am a master's student in Clinical Sports physiotherapy at the University of the Free State. I will be conducting a research study on the knowledge of concussion among South African rugby players.

Professional rugby teams have medical personnel at rugby matches. These medical personnel can easily identify a player that sustained a sports concussion and remove him safely from the field. Amateur players have no medical assistance and therefore player education becomes vital in order to help identify symptoms in fellow players.

With this study we want to investigate the knowledge among South African rugby players about sports concussion. The results of this study will benefit rugby players of South Africa by further promoting player safety on the field. By proving that there is a lack of knowledge about sports concussion among players, we can strongly motivate the need for player education. Amateur players often do not have any medical team personnel that can effectively identify concussion symptoms. Therefore by empowering the player with knowledge we can promote their on-field safety.

Your name will remain confidential and you may stop your participation in the study at any time. No compensation will be offered to participate in the study.

You will be required to complete a questionnaire that will take ten minutes to complete. Your participation will contribute to the on-field safety of South African rugby players.

The study has been approved by the evaluation committee of the School of Allied Health Professions at the University of the Free State, the (RUGBY TEAM) and the Ethics Committee of the Faculty of Health Sciences of the University of the Free State.

Please contact me with any questions: 084 511 9226 or viljoen.ct@gmail.com

I appreciate your consideration

Kind regards

CT Viljoen

Appendix F: Demographic data form

Demographic information form			
1	**Player code**		
2	**Team**		
3	**Age**		
4	**Height (cm)**		
5	**Mass (kg)**		
6	**What position do you mainly play? Choose one**		
	1 : Front row		
	2 : Lock		
	3 : Loose forward		
	4 : Scrumhalf		
	5 : Flyhalf		
	6 : Centre		
	7 : Back-three		
7	**What is your highest level of education?**		
	1 : Grade 1 - 7		
	2 : Grade 8 - 12		
	3 : Diploma		
	4 : Degree		
	5 : Postgraduate degree		
8	**For how many years have you been playing rugby?**		
9	**Have you ever had a concussion?**		
	Yes		
	No		
	If yes, how many times?		
10	**Have you ever received information about concussion?**		
	Yes		
	No		
	If yes, where?		