DETERMINING THE GENERAL- AND SPORTS-RELATED NUTRITION KNOWLEDGE OF MALE ADOLESCENT RUGBY UNION PLAYERS ATTENDING A SECONDARY, URBAN GOVERNMENT BOY'S SCHOOL IN PIETERMARITZBURG, KWAZULU-NATAL.

by

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ABSTRACT

Walsh, Cartwright, Corish, Sugrue & Wood-Martin (2011) suggest that the need for sound nutritional knowledge regarding both general concepts that pertain to healthy eating habits as well as the dietary principles that should be met for optimal sports performance, is of vital importance. According to Strachan (2009), adolescent sports-related nutrition knowledge is an area of great concern and in need of investigation, especially amongst local adolescent rugby players. Rugby is a high contact sport and the popularity of rugby union-related matches has considerably increased on a global scale (Griffiths 2012; Walsh *et al* 2011; Quarrie, Alsop, Waller, Bird, Marshall & Chalmers 2001). Unfortunately, Webb & Beckford (2013) and Burkhart (2010) recognize that there is limited published research available where an investigation into the general- and sports-related nutrition knowledge of adolescent athletes was conducted. This study aims to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending a boys only secondary, urban government school in Pietermaritzburg, KwaZulu-Natal.

A cross-sectional study was conducted on adolescent rugby players (N= 110) at a local urban, government school in Pietermaritzburg (mean age =15.22 ± 1.430). The players were requested to complete a nutrition knowledge questionnaire developed initially by Whati (2005) for urban South African adolescents. For the purpose of this study the questionnaire was adjusted in accordance with the study objectives using peer-reviewed journals.

The results showed that urban, government-level adolescent rugby players have an adequate general- and sports-related nutrition knowledge but lacked knowledge in the field of carbohydrates, understanding of what a well- balanced diet and healthy eating entails as well as the intake and role of protein. Parents and the media were selected as the two major sources of this information. More than half the participants admitted to using a nutritional supplement 3-4 times a week.

There was no statistically significant trend in the improvement of knowledge from the under 14 to the open age groups, perhaps emphasizing the lack of sound nutrition education. Several statistically significant trends regarding nutrition practices, such as

supplement use, were seen when comparing the open age group to the non-open age category; however the nutrition knowledge showed no statistically significant difference.

The results of this study correlate to similar published studies regarding nutrition knowledge of adolescent athletes. Due to the lack of locally published research concerning the nutrition knowledge of adolescent rugby players this study forms a reference point to the importance of determining the nutrition knowledge of adolescent athletes in order to understand the need for nutrition knowledge education.

PREFACE

The work in this dissertation was carried out by Bridgitte Stegen from the Dietetics and Human Nutrition, School of Agricultural, Earth and Environmental Sciences at the University of KwaZulu-Natal in Pietermaritzburg, South Africa, under the supervision of Suna Kassier and the co-supervision of Prof Frederick Veldman.
The work presented in this study is the original work of the author and has not; in any form for a degree or diploma; been submitted to any other tertiary institution. Appropriate acknowledgement was given where use was made of external sources of information and authors.

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DEDICATION

This dissertation is dedicated to my dearest nonna, Marisa Falzoi (1930-2012). The remarkable memory she left behind is my driving force to accomplishing a fulfilled life of success, love and happiness.

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CHAPTER 1: INTRODUCTION, THE PROBLEM AND ITS SETTING

1.1. Introduction and Importance of the study

Adolescence commences between the ages of eleven and thirteen and has a duration of approximately five to eight years (Weichselbaum & Buttriss 2014; Webb & Beckford 2013; Burkhart 2010; Stang, Taft Bayerl & Flatt 2006). This stage of the life span can prove to be physically and emotionally challenging due to the many physiological, social and psychological changes that adolescents face (Burkhart 2010; Stang *et al* 2006; Hoelscher, Evans, Parcel & Kelder 2002). In addition, these young adults also tend to change their eating habits and behaviours, however not necessarily for the better (Burkhart 2010; Sigman-Grant 2002). These changes can have a negative impact on future health, as many non-communicable diseases can develop during this stage of the life span and continue into adulthood (de Moraes, Adami, Falcão 2012; Yach, Hawkes, Gould & Hofman 2004).

Webb & Beckford (2013) have recognized that when an adolescent is also an athlete, poor nutritional habits become even more problematic as this could lead to current and future health concerns and sub-optimal athletic performance. The latter is of great concern, as globally as well as locally, the pressure to succeed in order to be taken into consideration for a scholarship at a secondary- and tertiary level of education and be accepted into a prestigious university or club has drastically changed the school-level sport division (Gradidge, Coopoo & Constantinou 2010). Strachan (2009); Bertelloni, Ruggeri & Baroncelli (2006) and Petrie, Stover & Horswill (2004), recognize that adolescent athletes are resorting to unsound eating habits and supplement use and abuse to improve their performance on the sports field in order to obtain the competitive edge over their peers. As previously mentioned, these practices can pose a risk to their current and future health (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004; Duhamel; Bougle, Guincestre, Laurans & Duhamel 1996). Weichselbaum & Buttriss (2014) state that due to the rapid growth spurt that takes place during adolescence, the macronutrient requirements to sustain growth as well as optimal sports performance, is substantial. This is why optimal nutrition is recognized as a vital component of an adolescent athletes' training schedule and lifestyle (Walsh, Cartwright, Corish, Sugrue & Wood-Martin 2011).

In order to bridge the gap between the nutritional requirements of adolescent athletes and their dietary intake, the need for sound nutritional knowledge regarding both general concepts that pertain to healthy eating habits as well as the dietary principles that should be adhered to for optimal sports performance, is of vital importance (Walsh *et al* 2011).

Strachan (2009) explains that sports-related nutrition knowledge of adolescents is an area of great concern and in need of investigation, especially amongst local adolescent rugby union players. South Africa is a country that is historically as well as currently renowned to achieve great success, particularly in the rugby union division (Krüger, Booysen & Spamer 2010). Following soccer and cricket, playing rugby at union level is the third most popular sport in South Africa with its popularity increasing on an annual basis as a result of the national South African team (Springboks) being ranked second by the International Rugby Board (IRB) and having a reputation for being amongst the most successful teams in the world (Anon 2014a). To date, the Springboks have won the World Cup twice; one game was hosted on home soil, a year after the abolishment of Apartheid (Anon 2014a). Hence, the 1995 win meant a lot for South African's of every age, race and gender as it united the nation at a time when South Africans needed it most (Anon 2014a). A subsequent win in France in 2007 enhanced the local popularity of the game even further (Anon 2014a).

It is therefore not surprising that as of 22nd August 2014 IRB South Africa announced that the rugby union has 423 581 registered male rugby players, with 29% (121 879) being adolescent males (Anon 2014a). Many of these young players aspire to one day playing at a provincial or national level such as their Springbok idols do. Thereby increasing the pressure of South African school rugby drastically (Krüger *et al* 2010). However, Anon (2014b) suggests that qualifying for a provincial or national team is not an easy feat and hence will remain a pipe dream for many young players. A more attainable goal is to work towards progression into the other levels at which rugby union is played from school level onwards (Anon 2014b). The process can be seen below:

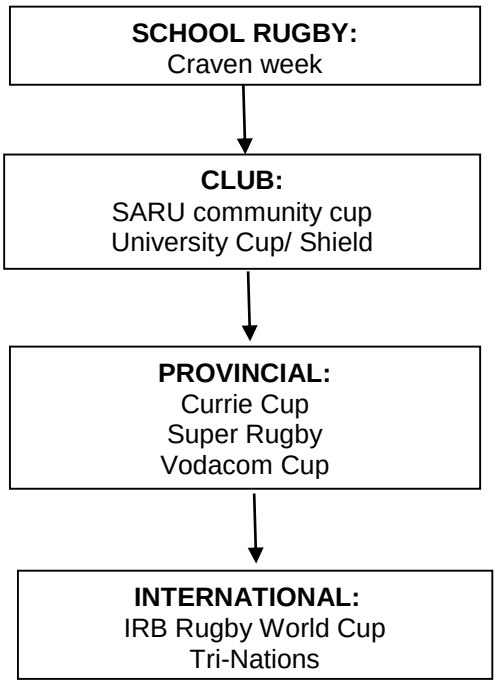

Figure 1.1: The process of selection and progression in South African rugby (Anon 2014b)

As the above figure indicates, school rugby union is the foundation on which aspiring rugby players will build their skill sets, be identified by clubs and possibly be selected to play at provincial level. Hence, rugby played at school level could dictate a player's future in the sport (Anon 2014b).

According to Griffiths (2012) and Quarrie, Alsop, Waller, Bird, Marshall & Chalmers (2001), rugby union is a high contact sport. During a rugby union match, there are 15 players in a team and on the field during any given game, namely 8 forward players and 7 backs (Griffiths 2012; Junge, Cheung, Edwards & Dvorak 2004). Gabbett (2013); Gabbett, Polley, Dwyer, Kearney & Corvo (2013); Waldron, Twist, Highton, Worsfold & Daniels (2011) and Walsh *et al* (2011) explain that a typical rugby union match lasts 80 minutes, consists of regular periods of high-intensity exercise (running and tackling) accompanied by longer sessions of low-intensity exercise and short episodes of recovery and rest.

Walsh *et al* (2011) and Chee (2010) suggest that due to the intermittent periods of exercise and rest, each player undergoes aerobic and anaerobic exercise throughout

the game. Smit (2012), Lambert (2009) and Deutsch, Kearney & Rehrer (2007) further explain that the forwards and backs play a different type of game. The forwards experience a high level of physical intensity through tackling and brawling with another player to get control over the ball. The backline players focus on receiving and running with the ball without being tackled. This results in forwards undergoing 12-13% of high-intensity exercise (of which 80-90% is rucking, mauling and scrumming) during a game as opposed to backs which only undergo 4.5% (of which 60-70% is sprinting and cruising). This implies that the physical attributes of forwards and backs differ substantially (Smit 2012; Lambert 2009; Deutsch *et al* 2007). Lambert (2009) and Durandt, Tee, Prim & Lambert (2006) explains that in order to gain and maintain the correct physical attributes in accordance with playing position, adequate physical conditioning needs to take place. A well-rounded and conditioned rugby player should have speed, power, agility, flexibility, skill and endurance (Lambert 2009; Durandt *et al* 2006). Smit (2012) and Uusitalo (2006) suggest that an inadequate diet is one of several factors that inhibits rugby players from achieving this state of conditioning required for optimal performance on the field. If this particular factor is not adequately met in accordance with the other factors involved, it could result in overtraining syndrome, poor performance and critical injuries (Smit 2012; Uusitalo 2006).

Smit (2012); Kamenju, Wanderi & Nteere (2006) and Meltzer & Fuller (2009) recognize that nutrition is a vital component to the rugby union player's overall achievement, performance and the health and safety of their body's. As a result, a rugby union player's diet needs to be tailored to meet the physical demands of training and competing. Adolescent rugby union players in particular, have a unique set of macronutrient needs that will sustain them during participation in this highly physical sport and maintain their growing nutritional needs and health (Walsh *et al* 2011; Petrie *et al* 2004).

Adequate, sound nutrition knowledge could help to improve overall sports performance and body composition in a safe and acceptable manner (Smit 2012). As a result, schools and rugby coaches should be encouraged to promote and disseminate accurate nutrition information amongst athletes, including the dangers associated with the use/abuse of main-stream or illegal supplements and substances. The necessary education and awareness would also emphasize the important role

that coaches can play in collaboration with dieticians to assist scholars in gaining a better understanding of optimal nutrition and appropriate supplement use, as this could reduce the risk of athletes falling prey to nutrition misinformation (Strachan 2009). Gordon (2012) also emphasizes the importance of adolescent athletes having access to accurate sports nutrition information and education and the role that qualified health professionals such as dieticians can play in improving nutrition knowledge.

A result by Webb & Beckford (2013) on the level of nutrition knowledge of the adolescent swimmers in Trinidad and Tobago and the link to whether nutrition education classes were taken becomes relevant here. The statistically significant result showed that the nutrition knowledge of the athletes that took nutrition education classes was higher than those who did not (Webb & Beckford 2013). This justifies the need for and value of sound nutrition education on these adolescent rugby players. Potgieter (2013) concluded that there no single source of nutrition information that can provide the necessary guidelines and requirements for optimal athletic performance, as a combination of guidelines tailored to the individual's needs will help to improve overall athletic performance. It is also emphasized that regular and appropriate counselling and advice regarding nutritional supplements is important, as a lack of knowledge could result in inappropriate consumption and result in poor health outcomes (Potgieter 2013).

According to Webb & Beckford (2013) and Burkhart (2010), there is limited published research regarding an investigation into the general- and sports-related nutrition knowledge of adolescent athletes. It was stated that, globally, there is more information available regarding the nutrition knowledge of adults and those that compete at college level (Webb & Beckford 2013; Burkhart 2010). The statements by the above authors were confirmed as a literature search using search engines such as Google Scholar, EBSCOhost and ScienceDirect as well as hand searches conducted on the South African Journal of Clinical Nutrition and the Journal of the American Dietetic Association underpinned the fact that there is a paucity of local and international published data regarding studies that investigated the general- and sports nutrition-related knowledge of adolescent athletes.

It has been established that optimal athletic performance is only possible if athletes consume an adequate diet, based on sound general- and sports-related nutrition knowledge. In order to achieve these goals in South African schools, Burkhart (2010) and Benardot (2006) postulate that it is vital to determine the nutrition knowledge gap in adolescent athletes, following which tailored general- and sports nutrition-related education and awareness should be incorporated into the school curricula or afternoon sports lessons (Burkhart 2010; Benardot 2006). The following chapter will highlight the importance of the study, statement of the problem and study design that was employed when conducting the study. The study objectives, parameters, and assumptions will also be presented. To facilitate a clear understanding of the topic under investigation, a definition of relevant terminology will be given as well as abbreviations that were used in the course of this dissertation.

1.2 Statement of the problem

To determine the general- and sports-related nutrition knowledge of male adolescent rugby union players attending a secondary, urban government boy's school in Pietermaritzburg, KwaZulu-Natal.

1.3 Type of study

A cross sectional descriptive survey was conducted to determine the general- and sports-related nutrition knowledge of the study population under investigation.

1.4 Objectives and null hypotheses

1.4.1 Objectives

- To determine the general- and sports-related nutrition knowledge and trends of male adolescent rugby players;
- To compare the general- and sports-related nutrition knowledge and trends of the forward and backline players;
- To compare the general- and sports-related nutrition knowledge and trends of male adolescent rugby players in each age group; under 14, under 15; under 16 and open (for the purposes of this study the data of the first, second, third and fourth teams were pooled to create the 'open' age category);

- To compare the general- and sports-related nutrition knowledge and trends of the open age group to the non-open age category (for the purposes of this study objective the under 14, under 15 and under 16 age groups were pooled together to create the non-open age category);
- To determine whether there is a progression/improvement in nutrition knowledge from the under 14 age group to the open age group;

1.4.2 Null hypotheses

- The general- and sports nutrition-related knowledge and trends of male adolescent rugby players will be poor and obsolete.
- There will be no difference in the general- and sports-related nutrition knowledge and trends between the forward and backline players.
- There will be no difference in the general- and sports-related nutrition knowledge and trends between the players the open age group and the non-open age category.
- There will be no progression in the general- and sports-related nutrition knowledge of male adolescent rugby players from the under 14 age group to open age group.

1.5 Study parameters

The school at which the study was conducted was selected according to the following inclusion criteria:

- It is the largest secondary, urban government boys school in Pietermaritzburg and surrounding areas;
- Rugby is offered as an extracurricular activity;
- Each team within the same age category regularly participate in competitive matches.

1.6 Assumptions

For the purpose of this study it was assumed that:

- The participants were truthful when completing the self-administered questionnaire.

- That the school selected for this study was representative of a typical urban boy's school.

1.7 Definition of terms

Adequate general- and- sports related nutrition knowledge: For the purposes of this study, an adequate general- and sports-related nutrition knowledge implies that more than 50% of the nutrition-related questions were answered correctly.

Adolescent: For the purposes of this study, an adolescent refers to an individual aged of 13 to 18 years.

Aerobic exercise: Fat, carbohydrates and oxygen are utilized to provide the muscle with energy in low- to moderate intensity and longer bouts of exercise (Gomes, Silva & de Oliveira 2012).

Anaerobic exercise: Carbohydrates but no oxygen is utilized during high intensity, shorter bouts of exercise (Gomes, Silva & de Oliveira 2012).

Dietary supplement: A nutritive product used to add additional nutritive value to the diet (Molinero & Márquez 2009).

Ergogenic aids: Non-food performance enhancing supplements (PES), that may or may not be banned or illegal and is consumed in order to improve athletic performance (Tokish, Mininder, Kocher & Hawkins 2004).

Hydration: Refers to the process of fluid consumption to avoid thirst and becoming dehydrated (Rodriguez 2012; American College of Sports Medicine 2007).

Hyponatremia: Refers to a low blood sodium level (a serum sodium level <130mmol/l) (Rodriguez 2012; the American College of Sports Medicine 2007).

Interval training: Refers to training periods of both aerobic and anaerobic exercise (Smit 2012).

Macronutrients: Carbohydrates, proteins and fats in the diet (Gerstein, Woodward-Lopez, Evans, Kelsey & Drewnowski 2004).

Nutritional supplement: A substance that can be consumed to provide additional nutritional value in terms of vitamins, minerals, proteins, carbohydrates, fat and energy to a person's diet in the non-food form for obtaining and maintaining health and well-being (Brown University 2014).

Non-open age category: For the purposes of a particular study objective the under 14, under 15 and under 16 age groups were pooled together to create the non-open age category.

Open age group: For the purposes of this study the first, second, third and fourth team representatives in the results were pooled together to create the open age group.

Post- body weight: For the purpose of this study this term refers to the weight of the athlete after exercising.

Post-workout meal: For the purposes of this study this term refers to the meal consumed after training or an athletic event the athlete participated in.

Pre- body weight: For the purpose of this study this term refers to the weight of the athlete before exercising.

Pre-workout meal: For the purposes of this study this term refers to the meal consumed before any training or athletic event the athlete participated in.

Pre-workout supplement: Refers to an ergogenic aid that is consumed prior to exercising to provide the athlete with energy and assist in achieving optimal athletic output during the workout (Tokish, Mininder, Kocher & Hawkins 2004).

Rugby Union: An intermittent game of high and low-intensity exercise played with 15 people on the field for 80 minutes; 40 minutes per half with a 10 minute rest break between each half (Gabbett 2013; Gabbett *et al* 2013; McLellan, Lovell & Gass 2011; Waldron, Twist & Highton *et al* 2011; Gabbett, Jenkins & Abernethy 2010; Gabbett, King & Jenkins 2008; Gabbett 2005).
For the purposes of this study rugby union will be referred to simply as rugby.

Sports Nutrition: "The integration and application of evidence based nutrition and exercise physiology principles that support and enhance training, performance, and

recovery" (Rodriguez 2012; Dunford & Doyle 2012).In addition, the concept of sports nutrition has developed around sport-specific, unique and individualized food and fluid requirements for each athlete (Burkhart 2010; Burke 2006). Rodriguez (2012); Dunford & Doyle (2012) and Benardot (2000) suggest that the somewhat recent concept of sports nutrition is rapidly expanding. Therefore further research is constantly being done to investigate the relationship between nutrition and athletic performance.

1.8 Abbreviations

ACSM:	American College of Sports Medicine
ADA:	American Dietetic Association
ADSA:	Association for Dietetics in South Africa
BMR:	Basal Metabolic Rate
CHO:	Carbohydrates
DRI:	Dietary reference intake
EA = EI-EEE:	Energy availability equals the energy intake minus the exercise energy expenditure
$_{est}$EA:	Estimated energy availability
FFM:	Fat free mass
g/kg BW/day:	Grams per kilogram body weight per day
IOC:	International Olympic Committee
IRB:	International Rugby Board
ISSN:	International Society for Sports Nutrition
kcal/kg:	Kilocalories per kilogram
kJ/kg BW/day:	Kilojoules per kilogram body weight per day
PES:	Performance enhancing substances
PMB:	Pietermaritzburg
SAIDS:	South African Institute for Drug-Free Sport
SPSS:	Statistical Package for Social Sciences
UKZN:	University of KwaZulu-Natal
WADA:	World Anti-Doping Agency

1.9 Summary

The success of rugby in South Africa and the subsequent increase in school boy rugby pressure leads to the alarming realities that an inadequate diet is one of several factors that inhibits rugby players from achieving the state of conditioning required for optimal performance on the field. It is vital to determine the nutrition knowledge gap in adolescent athletes, following which tailored general- and sports nutrition-related education and awareness should be incorporated into the school curricula or afternoon sports lessons. The current cross-sectional, observational study aims to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending a secondary, urban government boy's school in Pietermaritzburg, KwaZulu-Natal. Numerous objectives were developed to guide the study into accepting or rejecting the null hypotheses: the general- and sports nutrition-related knowledge of male adolescent rugby players will be poor and obsolete and there will be no progression in the general- and sports-related nutrition knowledge of male adolescent rugby players from the under 14 age group to open age group. The school in which the study was to be conducted was the largest secondary, urban government boy's school in Pietermaritzburg and surrounding areas, offered rugby as an extracurricular activity and each team within the same age category had to be regularly participate in competitive matches. It was assumed that the participants were truthful when completing the self-administered questionnaire and that the school selected for this study was representative of a typical urban boy's school.

In Chapter 2 a review of the relevant literature will be presented in order to highlight the importance of the study and facilitate the discussion and interpretation of the results generated by the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In Chapter 2, a review of the relevant literature will be presented to showcase the available body of evidence that serves as justification for inclusion of the questions forming part of the data collection tool (to be discussed in Chapter 3). In addition, the literature presented in Chapter 2 will also facilitate the discussion of the study results (presented in Chapter 4). As a result, the current chapter will cover the following aspects: physiological and social changes occurring during adolescence; sports nutrition concepts applicable to the adolescent athlete; the importance of assessing the nutrition knowledge of adolescents; understanding the nutritional requirements of adolescent athletes and rugby players and how it affects their performance and health; and the importance of nutrition education of adolescent athletes and concluding thoughts.

Crone & Dahl (2012) suggest that adolescence marks the period of many physiological, emotional, social, psychological and hormonal changes. Coupled with these bodily changes is the need for independence from parents and other family members. Unfortunately this sense of independence goes hand in hand with other challenges such as social and peer pressure and the ability of the individual to decide what and when they want to eat (Burkhart 2010; Sigman-Grant 2002). Weichselbaum & Buttriss (2014) explain that because this time of rapid growth and bodily change is coupled with the development of undesirable eating habits, adolescents may not be meeting their macronutrient requirements. However, of major concern is when an adolescent is also an athlete (Webb & Beckford 2013). If the adolescent athlete is already consuming an inadequate diet that does not meet their macronutrient requirements and makes poor food choices, this could result in poor athletic performance and future health concerns (Webb & Beckford 2013). In cases like these, the importance of education on general- and sports-related nutrition is emphasised (Walsh *et al* 2011).

Webb & Beckford (2013) and Burkhart (2010) recognize that there is a paucity of available data regarding the general- and sports-related nutrition knowledge of

adolescents and adolescent athletes in particular. In order to improve the nutrition knowledge of adolescent athletes globally as well as in South Africa, Burkhart (2010) suggests that the starting point should be to assess what adolescent athletes know, so that the integration of general- and sports-related nutrition education into school curricula can be justified.

2.2 Physiological and social changes occurring during adolescence

According to Burkhart (2010); Stang, Taft Bayerl & Flatt (2006) and Hoelscher, Evans, Parcel & Kelder (2002), puberty is a time where adolescents start noticing changes in their body shape and size, and coupled with that, social changes and challenges start emerging. Viner, Ozer, Denny, Marmot, Resnik, Fatusi & Currie (2012) highlight that the above mentioned challenges and changes present themselves through peer and parental pressure to adapt their personalities and responsibilities in accordance with the 'norm, coupled to the enormous social pressure to evade drug and alcohol abuse, violence and sexually risky behaviour (Viner, Ozer, Denny, Marmot, Resnik, Fatusi & Currie 2012). Crone & Dahl (2012) suggest that the bodily changes occurring in this stage of the life span involve significant increases in the levels of growth hormone, adrenal androgens and gonadal steroids, resulting in sexual maturity. Other than the changes in sexual development, these hormonal changes also lead changes in body composition, metabolism, personality and overall emotional and social behaviour (Crone & Dahl 2012). Burkhart (2010); O'Dea (2003) and Turconi, Celsa, Rezzani, Biino, Sartirana & Roggi (2003) observed that not only do these bodily changes occur during adolescence, but this stage see's many young adults seeking their personalities and personal characteristics (Burkhart 2010; O'Dea 2003; Turconi *et al* 2003). According to Weichselbaum & Buttriss (2014), the deviation from an individual's childhood eating habits are strongly associated with their ability to apply more influence and control over their preference and choice of food within a household and themselves. In addition, the increased independence that comes with growing up, also means that an adolescent has more spending power and is therefore able to purchase meals and snacks of their choice, regardless of the effects on their bodies (Weichselbaum & Buttriss 2014).

This sense of independence that develops during adolescence affects many facets of a teenager's life. Unfortunately, dietary habits and patterns are also greatly influenced and affected (Burkhart 2010; Turconi *et al* 2003; Hinton, Sanford, Davidson, Yakushko & Beck 2002; Hoelscher *et al* 2002). The social pressures that affect body image and self-esteem contribute to the majority of changes in dietary habits and patterns of these young adults (Burkhart 2010; Stang *et al* 2006; Hinton *et al* 2002). Burkhart (2010); Story, Neumark-Sztainer & French (2002) and Lytle (2002) suggest that the adolescent phase lends itself to new, unhealthy eating behaviours such as skipping important meals like breakfast, eating more unhealthy foods like fast foods and take-away's and drinking more sugar-sweetened beverages. Skipping breakfast seems to be a common occurrence in adolescents (Burkhart 2010; Lytle 2002). Corder, van Sluijs, Steele, Stephen, Dunn, Bamber, Goodyer, Griffin & Ekelund (2012) suggest that these dietary habits adopted by adolescents have negative effects on their overall dietary habits throughout the day and could possibly lead to the increased consumption of inappropriate snacks. Weichselbaum & Buttriss (2014); de Moraes, Adami, Falcão (2012); Yach, Hawkes, Gould & Hofman (2004); Popkin (2001) and Twisk, Kemper, van Mechelen & Post (2001) suggest that these undesirable dietary and lifestyle dietary choices and patterns made as an emerging adult, are linked to the development of numerous non-communicable diseases such as: obesity, cardio-vascular disease, hypertension and diabetes mellitus, in their current and future lives.

Burkhart (2010); Lytle (2002) and Hoelscher *et al* (2002) also note that coupled with emerging new, undesirable eating habits in this stage of the life cycle, adolescents also start eating fewer vegetables and fruit, fruit juice and milk. A particular source of concern is related to the possible decrease in milk consumption as was noted by Weichselbaum & Buttriss (2014). The latter authors highlight the process of calcium and phosphate deposition in the rapidly growing bones of these young adults, thereby drastically reducing serum calcium levels. In addition, the overall reduction in milk consumption is cause for concern, as this will reduce serum calcium levels even further (Weichselbaum & Buttriss 2014).

When an adolescent is also an athlete, the consequences of these undesirable lifestyle, dietary and physiological changes are magnified, as it will greatly affect their overall physical ability, athletic performance and ultimately their health (Webb &

Beckford 2013). In South Africa, Gradidge *et al* (2010) found that the amount of pressure that adolescents experience to achieve good results and improve overall skills in sport continues to rise and transmute. Krüger *et al* (2010) add that the identification of young athletes as potential future investments and successes has drastically increased from the 90's both globally and locally. Strachan (2009); Bertelloni *et al* (2006) and Petrie *et al* (2004) note that the level of competitiveness related to school rugby has increased considerably over the past decade due to the desire of adolescent athletes to be recognised by sporting bodies as future investments for the sport by those that train them and the team they present. As a result, the desire to be physically superior and perform better than peers in the same age category or league is taking its toll on the dietary adequacy of the adolescent athlete and their overall health (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004).

There are substantial increases in energy, macro and micro-nutrient requirements during adolescence (Webb & Beckford 2013). Weichselbaum & Buttriss (2014) highlight the critical difference between the body sizes of an adolescent when compared to their elevated nutritional requirements. A rapid growth spurt as well as the need for tissue repair and maintenance, result in increased requirements for macro- as well as micro nutrients. Thus, in order to establish a benchmark for future health and current success, adolescent athletes need to become more aware of the importance of knowledge regarding sports nutrition (Walsh *et al* 2011).

2.3 Basic concepts regarding sports nutrition applicable to the adolescent athlete

Rodriguez (2012) and Dunford & Doyle (2012) suggest that the somewhat recent concept of sports nutrition is rapidly expanding. This growing body of evidence related to sports nutrition has its benefits, as Burkhart (2010); Burke (2006) and Croll, Neumark-Sztainer, Story, Wall, Perry & Harnack (2006) found a positive relationship between nutrition and overall sports performance. The American Dietetic Association (ADA) (2009) also recognize that overall athletic achievement, output and recovery of an athlete can be improved through sound nutrition. Rodriguez (2012), Dunford & Doyle (2012) and Wolinsky & Driskell (2008) do not suggest a direct correlation between sound nutritional choices and achievement in sport, but explain that consistently making the wrong food choices or following an inappropriate diet will

negatively affect athletic performance and ability. The success of sports nutrition in its entirety is explained as the ability of the athlete to follow appropriate nutritional advice to maintain optimal health and avoid injuries whilst training and competing effectively (Rodriguez 2012). According to the ADA (2009), maintaining health and avoiding injury include aspects such as the maintenance of body weight, glycogen replacement and building and repairing muscle and other tissues. This can be achieved through adequate energy, carbohydrate and protein consumption. Fat also contributes to the maintenance of health and sporting achievements by providing essential fatty acids and fat-soluble vitamins, if consumed in adequate amounts (Rodriguez, DiMarco, Langly 2009). Webb & Beckford (2013) also recognize that numerous bodily process cannot be achieved without nutrition. Thus, in order to understand how nutrients are used in the body, how nutrients contribute to obtaining and providing energy and how nutrients affect many other important aspects of sports nutrition adequate and sound nutrition knowledge is required (Webb & Beckford 2013).

Due to its high impact and strenuous nature, there is an increased risk of injury amongst rugby players (Watson, Hodge & Gekis 2014) thus following a nutritionally adequate diet in accordance with sport nutrition-related guidelines is vital for adolescent rugby players in order to ensure current and future health and success (Trabucco, Nikoic & Mirkovic 2013; Jeukendrup & Cronin 2011). With its increase in popularity and the tremendous physical demands the sport places on rugby players' bodies as well as their health, rugby in particular became an area of concern in a study regarding the importance of sports nutrition awareness, the general- and sports-related nutrition knowledge and the need for nutrition education (Walsh *et al* 2011; Gabbett, Johns & Riemann 2008; Lundy, O'Connor, Pelly & Caterson 2006).

2.4 Nutrition knowledge of adolescents, adolescent athletes and rugby players and how it affects their performance

Burkhart (2010) states that there is a limited amount of research in the field of sports nutrition targeting adolescent athletes as opposed to adults. Webb & Beckford (2013) also found that there is a significantly less information regarding the nutrition knowledge of adolescent athletes in developing countries than there is for elite and collegiate athletes (Webb & Beckford 2013). Due to a lack of published research

regarding the nutrition knowledge of adolescent athletes, some of the literature referred to in the text below, was based on research conducted on collegiate athletes (Rodriguez 2012). However, it is felt that the data is also applicable to adolescent athletes.

In a study conducted by Webb & Beckford (2012), a nutrition knowledge questionnaire was used to assess the nutrition knowledge of 220 male and female swimmers aged 11 to 21 years residing in Trinidad and Tobago. There are several areas of nutrition knowledge that Webb & Beckford (2013); Davar (2012) and Zawila, Steib & Hoogenboom (2003) acknowledge as severely lacking in the adolescent athletes. These aspects include carbohydrate loading, the glycaemic index, role of protein and carbohydrates in the diet and its relevance to sports performance, the functions of vitamins and minerals, muscle energy sources, nutritional requirements and energy expenditure and how nutrients affect athletic performance. Although not statistically significant; Webb & Beckford (2013) also noted that the male participants had a higher overall average nutrition sore than the females. The culmination of these results lead to the authors concluding that there was a lack of nutrition knowledge in the study sample and therefore a dire need for nutrition education of these adolescent swimmers (Webb & Beckford 2013).

In research conducted by Burkhart (2010) and Rosenbloom, Jonnalagardadda & Skinner (2002), participants were asked to complete self-administered nutrition knowledge questionnaire. Findings were that subjects lacked knowledge regarding the use and role of protein in the body and had a poor understanding of the benefits and need for proper hydration. The findings of these studies therefore yielded similar results to studies that were previously cited that also assessed sport nutrition related knowledge (Burkhart 2010; Rosenbloom *et al* 2002). Burkhart (2010) also found that the adolescent athletes had a reasonable nutrition knowledge but lacked knowledge in areas of specific food components (carbohydrates and protein). Torres-McGehee, Pritchett, Zippel, Minton, Cellamare & Sibilia (2012) conducted a study on collegiate athletes in America. They, too, tested the nutrition knowledge of these athletes through a nutrition- knowledge questionnaire and found that only 9% of the collegiate athletes had an adequate nutrition knowledge. Burigo (2006); Mandali (2005); Batson, Sease, Stanek & Leski (2004) and Rosenbloom et al. (2002) all consistently found that

collegiate athletes have inadequate nutrition knowledge. Burigo (2006) conducted a study on 109 male and female collegiate athletes to assess their nutrition knowledge using a nutrition-based questionnaire. The author found that together with the result indicating their insufficient nutrition knowledge a result also showed their difficulty in understanding the role of protein in the diet, what a pre-exercise meal should contain and the role of vitamins and minerals in the body. Burigo (2006) also found that coaches were the main sources of nutrition information; a similar result is seen in studies done by Rodriguez (2012); Burkhart (2010); Strachan (2009) and Burns, Schiller, Merrick & Wolf (2004). Pirouznia (2001) conducted a study on the nutrition knowledge and eating patterns of 532 male and female adolescents (11-13 years old; thus the beginning stages of the period of adolescence) in the United States using a questionnaire to determine any associations between the two. The nutrition knowledge score ranged between 46% and 69% and Pirouznia (2001) indicates that overall they have an inadequate nutritional knowledge.

Walsh *et al* (2011) conducted a nutrition-knowledge questionnaire on 203 adolescent rugby players from six high-schools in Ireland. They found that the nutrition knowledge of these Irish adolescent rugby players was poor and that more attention needs to be given to nutrition education to correct or alter prevailing misconceptions regarding nutrition. Questions regarding hydration, specifically, were answered most accurately while the areas where players lacked knowledge included: sources of muscle energy, post-exercise meals and the importance and role of protein in sport. In addition, a high prevalence of supplement use was also confirmed with the majority of subjects believing that in it necessary to take a supplement to enhance training and performance. Sources of nutrition information and advice were predominantly coaches among two thirds of the study sample. However, the results highlighted the fact that there was an insignificant difference between the nutrition knowledge of rugby players that sought advice as opposed to those that did not, thereby suggesting that the source and quality of the information is as important as obtaining it (Walsh *et al* 2011). Walsh *et al* (2011) also found that more than 40% of the of the adolescent rugby players thought that the diets they follow were adequate to obtain maximal sporting results but when questioned on whether they found it easy to know what to eat, an alarming 62.6% answered that they do not know.

Torres-McGehee *et al* (2012) conducted a study on 400 collegiate athletes at the University of South Carolina in the United States using a sports-related nutrition knowledge questionnaire. They found that the athletes only scored 9% in the questionnaire indicating that they had a below average nutrition knowledge in all sports nutrition aspects (Torres-McGehee *et al* 2012).

Webb & Beckford (2013) recognize the impact of knowledge on the relationship between nutrients provided by the diet, how the body utilises them to maintain optimal health and prevent disease, how the body generates energy from food and how the body can recover from exercise, thereby highlighting the importance of sports nutrition knowledge. The authors further note that in order to maintain rapid growth and development, optimal health and succeed in their field of sport, adolescent athletes need to account for the increased nutrient requirements as well as the additional requirements for sports performance. This may be achieved by obtaining and understanding sound general- and sports-related nutrition knowledge. The reason why adolescent athletes lack the necessary nutrition knowledge, may be related to the many fallacies surrounding nutrition and the contradictory information regarding its effect on performance (Webb & Beckford 2013; Hornstrom, Friesen, Ellery & Pike 2011; Azizi, Rahmani-Nia, Malaee. Malaee & Khosravi 2010). The above authors also suggest that a lack of sound nutrition knowledge may be related to adolescents being exposed to unreliable sources of nutrition information resulting in them being misinformed. Strachan (2009) and Scofield & Unruh (2006) highlight the findings of a study conducted in Nebraska on 139 high school students whereby the sources of nutrition knowledge, specifically supplement usage, were investigated. Findings were that coaches were the primary source of nutrition information.

A local study was conducted by Broodryk & van den Berg (2011) on the opinion of high school rugby boys regarding the effectiveness of coaches. Broodryk & van den Berg (2011); Bloemhof (2008); Coakley (2005) and Fung (2003) highlight the critical change that has occurred in high school rugby and the consequent negative impact on the quality and availability of qualified coaching staff as more teachers volunteer to act as coaches in order to fill the coaching quota. The influence that coaching staff have on high school rugby is why this critical change is negatively perceived (Broodryk & van den Berg 2011; Horn 2002). Burkhart (2010) and Froiland, Kooszewski, Hingst

& Kopecky (2004) suggest that coaches are second on the list when it comes to sources of information (following shop assistants and preceding other athletes and friends) regarding supplement use by adolescent athletes. Burkhart (2010) and Kim & Keen (1999) also found that coaches were the source of information regarding supplements 13.4% of the time.

Burkhart (2010); Zinn, Schofield & Wall (2006) and Juzwiak & Ancona-Lopez (2004) suggest that coaches have a great influence on adolescent rugby players and therefore play a significant role in shaping and developing them within their team and themselves. Due to the close relationship between the coach and the athletes they coach, the nutrition knowledge passed on from the former to the latter may be positive or negative depending on the extent and accuracy of the nutrition knowledge being passed on (Burkhart 2010; Zinn *et al* 2006; Juzwiak & Ancona-Lopez 2004). Zinn *et al* (2006) assessed the nutrition knowledge of 168 high school coaches aged 30 to 50 years from New Zealand and investigated whether the athletes the coach rely on them for nutrition knowledge and advice (Burkhart 2010; Zinn *et al* 2006). The results suggested that the adequacy of coaches' nutrition knowledge was 55% and that 80% did provide nutrition advice to their team's/ athletes (Burkhart 2010; Zinn *et al* 2006). Although their nutrition knowledge was deemed to be above average, the study suggested that coaches had an inadequate nutrition knowledge as they scored low in area's involving fluid and hydration, the use and role of protein, carbohydrates and sport drinks and especially supplement usage (Burkhart 2010; Zinn *et al* 2006). Burkhart (2010) suggests that understanding of the role of protein in the body is a widespread problem among coaches.

2.5 Justifying the impact of optimal complete nutrition on a rugby players health and performance

2.5.1 Energy

Maintaining an optimal body weight, ensuring health and achieving optimal performance, are strongly associated with energy consumption in high intensity and endurance training such as weightlifting or basketball which are similar to rugby in terms of exercise pathways used (Rodriguez *et al* 2009). Sub-optimal energy intakes

are associated with loss of lean muscle, loss of bone density, increased risk of fatigue, injury and an extended recovery time (Rodriguez *et al* 2009). According to Rodriguez *et al* (2009), there are two major energy systems used during exercise to aid performance and endurance. These include the anaerobic (glycolytic/phosphagen) and aerobic (oxidative) systems. The anaerobic system is associated with exercise that lasts 1 to 1:30 minutes and uses rapidly metabolized glycogen and glucose. The oxidative pathway is activated when exercise lasts longer than 2 to 3 minutes, thereby relying on glycogen, triglycerides, amino acids and oxygen from the blood as substrates (Rodriguez *et al* 2009).

This concept is important to understand with regards to the energy needs of rugby players as players undergo a state of aerobic and anaerobic exercise during an 80 minute rugby game (Chee 2013). Short bouts of high-intensity exercise will use the anaerobic pathway to supply the player with a quick release of energy while lower-intensity, longer lasting exercise will start to rely on the aerobic pathway for a more continual and consistent energy supply (Smit 2012). Rodriguez *et al* (2009) and Mougios (2006) suggest that with low to moderate intensity exercise where the aerobic pathway is favoured, triglycerides from the muscle become the preferred source of fuel. Carbohydrates in the form of glycogen are also used, but are somewhat spared and will be used when the intensity of the exercise changes. Carbohydrates are the preferred source of fuel in an athlete during longer bouts of intense exercise or short bouts of highly-intensity exertion. This highlights the importance of adequate and appropriate muscle energy substrates and the balance of macronutrients, specifically fat and energy, in a rugby player's diet. As mentioned previously, Walsh *et al* (2011) found that this was an area of concern regarding the knowledge of Irish adolescent rugby players. A combination of the energy recommendations for athletes by the International Society for Sports Nutrition (ISSN); The American College of Sports Medicine (ACSM) and the International Olympic Committee (IOC) are highlighted by Potgieter (2013) and Rodriguez *et al* (2009) as these recommendations can be used to calculate the energy requirements of rugby players.

2.5.2 Carbohydrate

Rodriguez (2012); Burke, Hawley, Wong & Jeukendrup (2011); Ferguson-Stegall, McCleave, Ding, Doerner, Wang, Liao, Kammer, Liu, Hwang, Dessard & Ivy (2011) and Rodriguez *et al* (2009) state that carbohydrates are vital for athletic performance in ways that include its necessity to provide energy for muscles through conversion into glucose. This in turn sustains blood glucose levels and ensures that the glycogen stores lost through exercise, are replaced, as it also aids recovery. Carbohydrates are the major source of fuel that allows the rugby player's to perform optimally. Total carbohydrate intake depends on the total energy outputs regarding the specific sporting activity, the environmental temperature conditions, gender of the athlete and the total glycogen replacements needed post-workout (Rodriguez 2012; Burke *et al* 2011; Ferguson-Stegall *et al* 2011 and Rodriguez *et al* 2009).

Due to the numerous controversies regarding carbohydrate intake and exercise, a few new theories regarding carbohydrate intake are discussed in the section that follows. According to Potgieter (2013) and Burke *et al* (2011), the concept of periodization of carbohydrates in "train low and compete high" needs to be addressed. The basic principles underlying this concept are grounded on the idea that when an athlete trains at a lower intensity for a shorter period of time with depleted glycogen stores, the body transitions to a state where it recognizes its ability to utilize fat as a form of energy as opposed to carbohydrates. In order implement this theory effectively, an athlete needs to alter their diet to one with a high-carbohydrate content when competing to ensure optimal athletic performance. Potgieter (2013) and Burke *et al* (2011) also refer to a couple of misconceptions regarding this theory that simply states "train low and compete high" as this principle could help to improve the utilization of fat by the body during training and help spare muscle-glycogen stores. However, this could lead to diminishing the ability of the body to metabolise carbohydrates and could impair athletic performance. Overall, researchers realize there may be some benefit to training with low glycogen stores, especially during low-intensity or conditioning sessions, but the evidence is not sufficient enough to make any conclusive statements on the matter (Potgieter 2013; Burke *et al* 2011). With regard to rugby, the "train low and compete high" theory presents many flaws. According to Smit (2012), interval training that includes the combination of episodes both aerobic and anaerobic

exercise, is the most acceptable and frequently used means of training. Chee (2013) also suggests that the rugby player's main source of energy during training and matches should be derived from carbohydrates. Thus training on depleted glycogen stores will mean that the aerobic pathway won't be functioning optimally, thereby causing the rugby player to experience fatigue and as a result, sub-optimal training sessions (Smit 2012).

Non-rugby specific studies cited by Burkhart (2010); Montfort-Steiger & Williams (2007) and Petrie *et al* (2004) suggest that adolescents' and children's bodies use less carbohydrates and more fat during exercise. This has resulted in controversies as to whether a high carbohydrate or low carbohydrate diet is the preferred diet for adolescent athletes. However, due to inconclusive results, it is recommended that adolescents should eat a sufficient amount of carbohydrates, as carbohydrates will also provide the adolescent with fibre and important vitamins and minerals (Burkhart 2010; Montfort-Steiger & Williams 2007; Petrie *et al* 2004). Chee (2013) suggests that the carbohydrate requirements for a rugby player will be determined by the intensity, duration and frequency of training sessions. However, according to Chee (2013), rugby players need a high carbohydrate diet, that contributes more than half of the total energy intake per day.

The carbohydrates content of the pre- and post-training and competition meals will be discussed in due course.

2.5.3 Protein

Rodriguez (2012) and Benardot (2000) found that despite research indicating that carbohydrates are a vital source of muscle fuel, a growing trend is that many athletes believe protein is the macronutrient of choice that is responsible for successful athletic performance.

According to Rodriguez (2012); Fox, McDaniel, Breitbach & Weiss (2011); Hoffman, Ratamess, Tranchina, Rashti, Kang & Faigenbaum (2010); Moore, Robinson, Fry, Tang, Glover, Wilkinson, Prior, Tarnopolsky & Philips (2009) and Benardot (2000), protein is a vital component of the diet as it provides essential amino acids that the

body cannot manufacture. In addition, protein has a number of important functions that include building and maintaining tissues, helping to maintain fluid balance in the body and carrying substances in the serum.

Depending on the physical activity and athletic status of the athlete, Potgieter (2013); Dunford & Doyle (2012); Rodriguez (2012) and Rodriguez *et al* (2009), suggest that protein consumption should be higher than the general protein requirement for adolescents and should be adjusted depending on the type of sport, gender of the athlete and the athlete's overall goals that may include losing, gaining or maintaining lean muscle mass.

The provision of energy for athletes is a secondary function of protein and only becomes necessary when an insufficient amount of carbohydrate or fat is consumed (Rodriguez 2012; Fox *et al* 2011). Therefore, in order for the body to optimally utilize the protein consumed through the diet and for it to be used for its primary bodily functions, a diet with an adequate kilojoule content should be consumed (Rodriguez 2012; Rodriguez *et al* 2009). Due to the high-impact nature of rugby, Smit (2012) highlights the fact that protein is a vital component of a rugby player's diet. Both the backline and forward players need protein due to its general functions in the body. However, it is the forwards in particular that require adequate protein due to the rucking, mauling and scrumming to facilitate the protection, maintenance and repair of muscle (Smit 2012). Chee (2013) suggests that rugby player's should be consuming large amounts of protein (up to 3g /kg BW/ day). However, this recommendation contradicts the IOC's recommendation that the body cannot utilize protein intakes higher than 1.8g/kg BW/day (Potgieter 2013).

2.5.4 Fat

Dunford & Doyle (2012); Rodriguez (2012) and Rodriguez *et al* (2009) explain that the most important role of fat in the diet is that it aids the absorption and transport of fat-soluble vitamins A, D, E and K. Coupled to that, fat provides essential fatty acids, contributes to certain hormonal systems, plays a role in the satiety mechanism and also contributes to the total energy intake, thereby becoming a source of muscle fuel. The general recommendations for adults and athletes by the ACSM is that fat should

contribute about a third of the total energy intake. Low fat diets, i.e. below 20% of the total energy intake have shown to negatively impact on overall athletic performance and should therefore be avoided. This is especially important in endurance training as the depletion of carbohydrate stores result in the body resorting to using fat as an energy source, predominately in the form of free fatty acids. If fat stores are insufficient, the body could resort to using protein as its secondary source of fuel. The latter could result in compromising the maintenance of muscle and other tissue as well as their repair (Dunford & Doyle 2012; Rodriguez 2012; Rodriguez *et al* 2009).

Chee (2013) and Darry (2000) suggest a fat intake of 20-25% of the total energy intake for rugby players. This is similar to the ACSM recommendations (Nancy; Rodriguez 2009). Fat intakes in excess of 25% of the total energy could result in an overall reduction in carbohydrate intake which is vital for rugby players (Chee 2013; Darry 2000). As was previously mentioned by Smit (2012) and Rodriguez *et al* (2009), low to moderate intensity exercise that uses the aerobic pathway (taking place for the majority of time in the course of a rugby match) relies on fat as one of its sources of fuel. This highlights the importance of a balance between the macronutrients in a rugby player's diet, specifically regarding the energy substrates fat and carbohydrates (Smit 2012; Rodriguez *et al* 2009). As consistent findings point toward the fact that an adolescent's diet comprises of high fat foods obtained from take-out or convenience foods (Burkhart 2010), this is seen as a vital aspect that adolescents need to be made aware of, as it could make a significant contribution to their fat intake. On the other hand, in emphasising the importance of avoiding low fat diets, Rodriguez (2012) and Burke *et al* (2004) found that there are studies suggesting that a high fat diet along with limited carbohydrates can enhance overall training ability. However, there is currently a lack of sound evidence to support this theory (Rodriguez 2012; Burke *et al* 2004).

2.5.5 Fluid and hydration

Dehydration is defined as a loss of water equivalent of 2%-3% of body weight (Rodriguez 2012; Dunford & Doyle 2012; Hoffman 2011; Rodriguez *et al* 2009; Shireffs, Casa & Carter 2007). This can severely inhibit an athlete's performance and negatively affect their health. Therefore adequate fluid consumption before, during

and after exercise is a vital component of the athletes diet (Rodriguez 2012; Dunford & Doyle 2012; Hoffman 2011; Rodriguez *et al* 2009; Shireffs, Casa & Carter 2007). Other than the harmful physiological effects dehydration has on the body, hyponatremia (a serum sodium level <130mmol/l) can be caused by large fluid losses with inadequate fluid replacement containing sodium (Rodriguez *et al* 2009). Rodriguez (2012) and ACSM (2007) provide a sound method of determining the hydration status of athletes that involves measuring body weight before exercise and immediately after exercise. In so doing, losses of body fluids through sweat can be determined and adequate replacement of hydration needs can be implemented (Rodriguez 2012; ACSM 2007). According to Rodriguez (2012); Hoffman (2011) and Rodriguez *et al* (2009), the importance of understanding fluid requirements is to prevent dehydration which can have several negative effects on the athlete's body and performance before it occurs. Symptoms of dehydration only occur after fluid losses of 1% - 2%. Thus, thirst only sets in close to the point of dehydration (Rodriguez 2012; Hoffman 2011; Rodriguez *et al* 2009).

Meltzer & Fuller (2009) recognize that the erratic nature of a rugby game provides players with ample opportunity to consume fluids and stay hydrated. These authors suggest that fluid is best absorbed when the stomach is moderately full. Thus they suggest that a means of keeping rugby players hydrated is to ensure that they had a beverage before the game commences and then maintaining fluid intake through small amounts throughout the game.

The rugby union suggests that when there is minimal time for recovery post training, the fluid replacement should be 150% of the lost fluid calculated by the body weight deficit (Meltzer & Fuller 2009). Fluid can be replaced with safe, clean water and or sports beverages (Rodriguez *et al* 2009). Regarding rugby players, Meltzer & Fuller (2009) suggest that water is not the ideal drink for training and games. A 5-8% carbohydrate containing beverage with small amounts of sodium are preferable for these athletes. Here it is important to note that the difference between sport and energy drinks. Schneider & Benjamin (2011) define sports drinks as liquid refreshments that are used to replace glycogen, fluid and electrolyte losses during a sporting activity as it contains carbohydrates, minerals and electrolytes. Contrary to that, energy drinks cannot be used to replenish lost fluid and electrolytes as they

contain nutrient-free stimulants in the form of caffeine, guarana, taurine, ginseng, L-carnitine and creatine. Some of these drinks may even provide ergogenic and performance - enhancing effects (Schneider & Benjamin 2011).

2.6 Meal timing and macronutrient composition: pre, during and post-exercise

According to Rodriguez (2012); Burke *et al* (2009); Kerksick, Harvey, Stout, Campbell, Wilborn, Kreider, Kalman, Ziegenfuss, Lopez, Landis, Ivy & Antonio (2008) and Benardot (2000), the timing of meals are just as important in sports nutrition as consuming the appropriate macronutrients. In sports nutrition, timing of meals are generally referred in three categories namely (i) pre-exercise; (ii) during exercise; and (iii) post training/ recovery (Rodriguez 2012; Rodriguez *et al* 2009):

2.6.1 Pre-exercise

There are a number of contradicting findings/opinions regarding the benefits of eating before exercise (Rodriguez *et al* 2009). In addition, there is also a debate regarding how long before exercise commences, should food be consumed (Rodriguez *et al* 2009). Rodriguez *et al* (2009) states that there is a direct relationship between the sizes of the meal ingested before exercise commences and the time that it is eaten. Some athletes tolerate the consumption of high energy meals two hours prior to a competition, while others experience gastro-intestinal distress when eating a large meal before exercising. As a result, they resort to eating smaller meals with a substantially energy content up to 30 minutes before exercising (Rodriguez *et al* 2009). Depending on when an athlete chooses to eat, Rodriguez (2012); Rodriguez *et al* (2009) and Kerksick *et al* (2008) recommend that a pre-exercise meal should contain: (i) a significant amount of carbohydrate to maintain blood glucose levels; (ii) a low fat and fibre content to enhance gastric emptying, thereby preventing gastric discomfort during training, and reasonable protein content. It is also suggested that the athlete should be familiar with the food consumed, so that tolerance is known (Rodriguez 2012; Rodriguez *et al* 2009; Kerksick *et al* 2008). According to Potgieter (2013), the ACSM and IOC recommend that the pre-exercise meal should be low in protein as protein is of greater importance in the recovery stage and the carbohydrate content of the meal should be the main focus at this time (Potgieter 2013). Meltzer & Fuller (2009)

suggest that rugby players should consume a high carbohydrate, moderate protein and low fat meal at least three hours prior to commencement of the game.

2.6.2 During exercise

During exercise an athlete should mainly focus on drinking sufficient fluids to replace sweat losses and to eat enough carbohydrates to maintain blood glucose levels (Rodriguez 2012; Hoffman 2011; Rodriguez *et al* 2009). Consuming carbohydrate in a liquid form with a 6% to 8% solution, could be the most practical way of ingesting carbohydrate during exercise. Sports drinks of the concentration indicated, are also digested quickly, thereby allowing for a more rapid response (Rodriguez 2012; Hoffman 2011; Walsh *et al* 2011; Rodriguez *et al* 2009). The latter authors also recommend that the athlete should consume the necessary carbohydrates in the form they are familiar with (Rodriguez *et al* 2009). Consuming carbohydrates during exercise is of greater importance if it has a duration in excess of 60 minutes, when the weather and environmental conditions require increased fluid and glucose requirements and if the athlete has not consumed an adequate amount of energy throughout the day. As a rugby is a game with a duration of 80 minutes, consuming carbohydrates during the match or practice session can help to ensure that protein sparing occurs and therefore is not used as a source of energy (Rodriguez 2012; Hoffman 2011; Walsh *et al* 2011; Rodriguez *et al* 2009). Potgieter (2013); Kerksick *et* al (2012) and Rodriguez *et al* (2012) explain that there is inconclusive evidence regarding the benefits of protein consumption during exercise. In exercise that would be classified as endurance or resistance training, it may be beneficial but in most instances, protein in more important in the recovery period, post-exercise (Potgieter 2013; Kerksick *et* al 2012; Rodriguez *et al* 2012).

2.6.3 Post-exercise/ recovery

A number of factors need to be taken into consideration regarding the post-exercise meal: (i) the duration of the workout (endurance sports with a duration of more than 90 minutes have a higher rate of glycogen depletion than those of a shorter duration); and (ii) when the athlete is planning on commencing the next exercise session (Rodriguez *et al* 2009). The primary goal of the post-exercise meal is to replace the

energy, carbohydrate, protein, fluid and electrolytes lost as a result of the exercise (Dunford & Doyle 2012; Rodriguez 2012; Hoffman 2011). Failure to replace these losses, could result in decreased performance in the next game or training session and could also impair the athlete's health in the long run (Dunford & Doyle 2012; Rodriguez 2012; Rodriguez *et al* 2009).

Rodriguez (2012) and Walsh *et al* (2011) agree that glycogen stores are replenished most efficiently in the first hour after exercise. It is vital that the post-exercise/recovery meal or drink should contain carbohydrates to replenish glycogen stores as well as a small amount of protein that will help muscle and other tissue repair and maintenance (Rodriguez 2012; Walsh *et al* 2011). Potgieter (2013) and Rodriguez *et al* (2012) acknowledge that post-exercise consumption of carbohydrate and protein is of more importance when an athlete has minimal recovery time before the next training session and/or match. If the recovery time is 24-36 hours before the next event, then the timing of nutrient intake is not that important. However, it should be ensured that sufficient carbohydrates are consumed within 24 hours post-exercise and that daily carbohydrate requirements are met on a daily basis until the subsequent event as well as thereafter (Potgieter 2013; Rodriguez *et al* 2012).

Smit (2012) and Mashiko, Umeda, Nakaji & Sugawara (2004b) highlight that the nutrient composition of the recovery meal for rugby players differ depending on their position in the team. Backline players need to consume meals of a higher energy content, high in carbohydrate and moderate in protein, whereas front-line players have higher protein requirements. The latter is mainly due to the increased amount of muscle damage incurred by front-line players who play a far more physical game (Smit 2012 and Mashiko *et al* 2004b). The post rugby game recovery goal is to replenish lost fluid, glycogen and protein stores within the first five minutes after the game (Smit 2012; Jeffreys 2005). It is suggested that this can be achieved by eating or drinking carbohydrate and protein in a ratio of 4:1 (Smit 2012; Jeffreys 2005). Meltzer & Fuller (2009) do not emphasize the importance of protein in a post rugby game recovery meal but rather that carbohydrate should be consumed within 30-40 minutes post match and frequently thereafter until their next meal (Meltzer & Fuller 2009).

Milk is mentioned as an appropriate post exercise recovery beverage as it contains carbohydrates in quantities and forms similar to commercial sports drinks and a casein to whey protein ratio of 3:1. This results in slower digestion and raised serum amino acid content for a longer period. It also contains electrolytes lost through sweat during exercise. The whey also provides the body with a substantial amount of branched chain amino acids, which play a major role in building, repairing and maintaining muscle (Roy 2008). In addition, milk is a good alternative to commercial sports drinks as it is nutritious, freely available, tasty, cost effective and culturally acceptable (Rodriguez 2012; Ferguson-Stegall *et al* 2011; Gilson, Saunders, Moran, Moore, Womack, Todd 2010).

2.7 Nutrient supplements and ergogenic aids

Due to the competitive nature of sport, athletes experience an intense burden to perform and excel (Webb & Beckford 2013). Strachan (2009) explains that even at South African school-level, optimal sports performance is emphasised from a young age and athletes strive towards victory, irrespective of the financial physiological consequences (Gradidge *et al* 2010; Strachan 2009). In order to enhance performance, numerous athletes are now resorting to supplement use (Molinero & Márquez 2009). The term supplements can be collectively and unofficially categorised in two ways namely nutritional supplements and ergogenic aids (Molinero & Márquez 2009). The latter authors define nutritional supplements as: “a product that is intended to supplement the diet (although unnecessary and often harmful) including food products and non-prescription medicines”. Molinero & Márquez (2009) are of the opinion that nutritional supplements lead to the creation of ergogenic aids, which are an umbrella term for numerous and often illegal, expensive, unnecessary and potentially harmful performance enhancing supplements (PES). Molinero & Márquez (2009) and Maughan (2005) comment on an increase in the prevalence of doping, i.e. the use of illegal ergogenic aids, and nutritional supplements. Maughan (2005) found that incorrect and incomplete labelling of legitimate nutritional supplements mean that some of these products, used by athletes of all ages, contain ingredients that are prohibited. The incomplete labelling could be attributed to the fact that this is an unregulated market (Molinero & Márquez 2009).

According to Molinero & Márquez (2009) nutritional supplements and ergogenic aids are highly advertised and endorsed in the media and by famous personalities and sportsmen, claiming to enhance performance, regardless of the lack of scientific evidence supporting their use, coupled with the fact that they could be harmful to health and are often expensive. Unfortunately the unregulated market for nutritional supplements has resulted in a wide variety and availability (Molinero & Márquez 2009). In an attempt to regulate the use of ergogenic aids, some have been banned for use by athletes (Molinero & Márquez 2009). The World Anti-Doping Agency (WADA) is recognised as being at the forefront in the battle against substance abuse in sport (Gradidge *et al* 2010). The latter authors mention that WADA contributes to regulating substance abuse by providing an annually updated list of the PES that are banned. This form of control is also implemented in South Africa, as the South African Institute for Drug-Free Sport (SAIDS) conforms to the list of banned substances annually released by WADA (Gradidge *et al* 2010). Rodriguez (2012) notes that supplements that are available over-the-counter and have been researched, have been found not to enhance performance, increase muscle mass or reduce body fat. According to Rodriguez (2012) and Green, Catlin & Starcevic (2001) an American study conducted on 12 over-the-counter products found that 11 of the 12 products had misleading labels that did not comply with the Dietary Supplement Health and Education Act (DSHEA). Molinero & Márquez (2009) have suggested that regardless of the availability of information regarding nutritional supplements and ergogenic aids, athletes remain misinformed regarding their affectivity. Hence, it is felt that more attention should be paid to this aspect in competitive sport as the use of supplements is currently unsupervised and unlimited (Molinero & Márquez 2009). Tokish, Mininder & Hawkins (2004) agree with this statement by implying that with the need for athletes to perform optimally and gain the competitive edge, the use of freely available ergogenic aids are not likely to decrease (Tokish *et al* 2004).

Strachan (2009); Bertelloni *et al* (2006) and Petrie *et al* (2004) express concerns regarding the safety of ergogenic aids and the fact that the long-term health of adolescent athletes should be a top priority. With the tremendous physical demands placed on adolescent sportsmen over and above the social, psychological and physiological demands of adolescence, their health may be compromised and viewed as being of lesser importance. The majority of adolescent athletes have rigorous

training schedules and may be competing numerous times per week in more than one sport (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004). Training schedules may commence several weeks before the start of the sporting season and with the possibility of being recruited by university's or clubs, young athletes are training harder and longer to gain the competitive edge (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004). According to Strachan (2009); Bertelloni *et al* (2006) and Petrie *et al* (2004) the pressure to compete and extensive training results in changes to their dietary requirements. In addition, it is possible that their dietary habits are already poor (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004). The above is great cause for concern in terms of short- and long-term health (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004). As it would seem that adolescents have a lack knowledge regarding general- and sports-related nutrition but knowledge is not necessarily related to behaviour (Strachan 2009; Bertelloni *et al* 2006; Petrie *et al* 2004). It is vital to determine the most effective way of conveying nutrition knowledge to adolescent athletes (Strachan 2009, Bertelloni *et al* 2006; Petrie *et al* 2004). It is therefore not surprising that Ralph (2012) postulates that the method used to transfer nutrition knowledge to athletes is important to consider.

According to Meltzer & Fuller (2009), it is recognised that the body composition of rugby players will differ according to player position and the physical goals set at each stage in the season. In the course of the rugby season, players mainly undergo two physical changes namely weight (fat) loss and an increase in muscle mass. These changes cannot occur simultaneously as they differ in terms of nutritional requirements. Fat loss would require a reduction in energy intake, whereas an increase in lean muscle mass would require a higher energy intake. In order to achieve these goals, an understanding of the role and importance of macronutrients in a rugby player's diet and performance is vital (Meltzer & Fuller 2009).

2.8 Nutrition education of adolescent athletes

Rodriguez *et al* (2009) stated that in order for athletes to achieve optimal sporting performance and adequate recovery in athletes, nutrition education is vital. Casazza & Ciccazzo (2007) identify that “adolescents remain one of the most underserved populations, especially minority youth with respect to nutrition and health education”. There is inconclusive evidence regarding whether nutrition knowledge affects dietary behaviour (Burkhart 2010). But a number of recent studies underpin the fact that perhaps nutrition behaviour is influenced by dietary knowledge (Steyn 2010). van Cauwenberghe, Maes, Spittaels, van Lenthe, Brug, Oppert & de Bourdeaudhij (2009) believe that in Europe, nutrition programmes delivered in a school setting could reach almost 100% of the children and adolescents. Perhaps the same thing could be seen for South African schools.

Steyn (2010) highlights the findings of a study whereby the link between knowledge of dietary fat intake and actual fat intake of adolescents in public schools in Cape Town was assessed. The study found that more than half the participants had a poor nutritional knowledge regarding fat. However, of those participants who had higher nutrition scores, the majority indicated that they received nutrition education at school and were also more likely to be interested in nutrition. The results indicating a link between nutrition knowledge regarding fat intake and actual fat intake that were statistically significant for this study sample. Webb & Beckford (2013) also found a statistically significant result in their study that indicated a position line of progression between the number of nutrition classes/ courses attended and the overall nutrition knowledge score. To further the justification of that result they also found a statistically significant link between the nutrition knowledge and attitude towards nutrition (Webb & Beckford 2013). Walsh *et al* (2011) found there was no statistically significant difference in the nutrition knowledge scores between the adolescent rugby players who had received nutrition education and those who hadn’t. Walsh *et al* (2011) and Zinn *et al* (2006) account for this result by assuming that perhaps the level and accuracy/ relevance of the nutrition education received was not up to the scientific and accurate standards they may have received from a qualified nutritionist. The coaches were listed in the study by Walsh *et al* (2011) as the main source of nutritional information. Although less than 50% of the study participants showed an interest in

further nutrition education, the fact that majority of the participants receive their nutrition information from the coaches cannot be disregarded as the source of the coach's knowledge is questionable (Walsh *et al* 2011). Webb & Beckford (2013) also found that the adolescent swimmers showed an interest in nutrition education and believed that it may have a positive impact on them. They further found that conducting sound nutrition education may do two things: improve their overall nutrition knowledge and improve their attitude and behaviour towards nutrition (Webb & Beckford 2013).

Steyn (2010) explains that nutrition knowledge can possibly influence eating behaviour and that schools should be the route for transferring nutrition knowledge to adolescents. Several studies assessed by Steyn (2010) involving curriculum-based nutrition education programmes targeting adolescents, yielded positive results regarding the association between nutrition knowledge, behaviour and attitude towards diet. Steyn (2010); Mihas, Mariolis, Manios, Naska, Arapaki, Mariolis-Sapsakos & Tountas (2009) and Birnbaum, Lytle, Story, Perry & Murray (2002) documented the fact that a few school-based nutrition education programmes had a positive impact on adolescent dietary behaviour, especially in terms of fat consumption. One particular programme including an intervention component, yielded positive results regarding a decrease in dietary fat (Steyn 2010; Mihas *et al* 2009; Birnbaum *et al* 2002), while another 11 week programme (Steyn 2010; Mihas *et al* 2009; Birnbaum *et al* 2002) also found a substantial increase in the nutritional knowledge of adolescents and a significant decrease in saturated fat and cholesterol intake (Steyn 2010; Mihas *et al* 2009; Birnbaum *et al* 2002). Steyn (2010); Bere, Veierod, Bjelland & Klepp (2006) and Kain, Uauy, Albala, Vio, Ceda & Leyton (2004) refer to the fact that there are some nutrition-based interventions that found little or no positive result, thereby substantiating the opinion by Burkhart (2010). Regardless of the inconclusive evidence, Steyn (2010) acknowledges the fact that the ideal intervention would be for adolescents to be given knowledge regarding appropriate dietary behaviours at school as well as home. It is thought that these behaviours and lessons learnt will influence their eating habits into adulthood, thereby having an impact on their future lifestyle as well.

Burkhart (2010) reiterates the need for adolescents to have the necessary nutrition knowledge that includes, not only general concepts regarding healthy eating, but also

information related to sports nutrition. Having the necessary nutrition knowledge will not only enable them to attain optimal health and growth, but could facilitate their ability to achieve their sporting potential.

The most effective way of improving nutrition knowledge is through nutrition education and awareness (Burkhart 2010). However, there is a lack of clarity regarding the best medium to use when conducting nutrition education targeting adolescent athletes (Burkhart 2010). Burkhart (2010) is of the opinion that the goal of nutrition education is to increase the adolescent athlete's general- and sports-related nutrition knowledge and motivate them to implement and maintain changes to their diet (Burkhart 2010). In addition, the nutrition education should include aspects that are of interest to the adolescent athlete (Burkhart 2010). The adolescent athlete may also be more likely to show interest in learning more if the information is related to the attainment of success in their particular field as opposed to their future health (Burkhart 2013; Litt 2004). Durlak, Weissberg, Dymnicki, Taylor & Schellinger (2011); Blum & Libbey (2004) and Learning First Alliance (2001) advocate that a major factor to consider when discussing high-school education and intervention programs is the tendency of these young adults to start socially rejecting the learning and education scene. They also begin losing the connection and motivation they retained with their peers and teachers at primary school level (Durlak *et al* 2011; Blum & Libbey 2004; Learning First Alliance 2001). This negatively impacts the learning outcomes of these adolescents and thus fortifies the need of educators to individualize and adapt education to best suit the culturally and individually diverse scholars (Durlak *et al* 2011; Blum & Libbey 2004; Learning First Alliance 2001).

Casazza & Ciccazzo (2007) suggest three strategies ways for implementing successful dietary interventions. These include cognitive, affective and behavioural techniques. According to Casazza & Ciccazzo (2007) behavioural techniques are the most effective ways of implementing successful dietary interventions. Casazza & Ciccazzo (2007) explain that the cognitive approach to nutrition education involves the relaying of important and relevant information and messages to the adolescent. The affective approach entails using the beliefs, attitudes and perceptions of adolescents regarding healthy dietary habits and providing tips and strategies to assist them in achieving their dietary goals. The behavioural approach involves the process of

change, whereby adolescents are guided on how to set their goals, learn new skills and take responsibility for their own health and dietary practices.

It is suggested that the nutrition educator needs to assess the sport-specific needs and individual goals within a specific sport when conducting nutrition education (Burkhart 2010). According to Burkhart (2010) and Benardot (2006) in a team sport such as rugby, each team player may have individual needs. Hence, the needs of the team may differ between player positions. However, it is important for each team member to understand their own requirements as well as that of their team members in order to develop a cohesive unit (Burkhart 2010; Benardot 2006). Burkhart (2010); Sigman-Grant (2002) and Hoelscher *et al* (2002) explain how studies have shown that nutrition intervention programmes that include appropriate activities aimed at the target group is important. Conducting lectures on good dietary practices won't necessarily result in knowledge retention and implementing that which was learnt in theory. The above authors found that sometimes nutrition programmes including other behaviours as well as dietary ones, are more likely to have an overall positive impact. Conducting group lessons where informal discussions can take place, is viewed as one of the most beneficial ways to get adolescents to participate (Burkhart 2010; Sigman-Grant 2002; Hoelscher *et al* 2002). Casazza & Ciccazzo (2007); Brug, Oenema & Campbell (2003); Oenema, Tang & Brug (2005); Probst & Tapsell (2005) and Kriesel (2004) believe the most effective method of engaging in the behavioural aspect of the adolescent is to use computer-based education programs. They can be tailored to the individual, can be kept up-to-date with scientific, easy to read literature and computers can create a number of other exciting opportunities such as easy access from anywhere in the country or world, access from a place of their choice and access whenever they would like. Hoelscher *et al* (2002) and Casazza & Ciccazzo (2007) suggest that this method of nutrition education may be more effective than the traditional means of "teaching" as this means has shown little to no improvement or success. Friedman, Cosby, Boyko, Hatton-Bauer & Turnbull (2010) highlight a study done by Beranova & Sykes (2007) on the effectiveness of computer-based teaching methods used for heart disease patients. The study showed a noteworthy enhancement in the patient's knowledge and their learning ability and knowledge seemed to continue increasing as far as 6 months after their intervention (Friedman, Cosby, Boyko, Hatton-Bauer & Turnbull 2010; Beranova & Sykes 2007). Ranmal,

Prictor & Scott (2008) also found a positive correlation between computer-based education and the knowledge of the children and adolescent patients.

Ralph (2012) highlights another three ways to deliver nutrition knowledge to an adolescent athlete. The first approach would be power point presentations including visual, verbal and written forms of knowledge transfer. Scholars could be given a hand out of the presentation which could be used for note taking and be used as a future source of reference. This approach is easier with smaller groups of people and may be beneficial for teachers and coaches to attend (Ralph 2012; Perez-Rodrigo; Aranceta 2003) This approach would coincide with the evidence suggested by Casazza & Ciccazzo (2007); Brug *et al* (2003), Oenema *et al* (2005); Probst & Tapsell (2005) and Kriesel (2004) that electronic means of communication and presenting current and accurate data may be more effective than the other two more 'traditional' means of teaching highlighted by Ralph (2012) below. The second approach would be to develop a practical, skill-building intervention that includes family and friends that could participate in demonstrations such as meal planning, cooking and tasting sessions. Implementation of the latter however, would only be possible if the necessary resources are available and if parents are able participate. van Cauwenberghe, Maes, Spittaels, van Lenthe, Brug, Oppert & de Bourdeaudhij (2009) justify the idea posed by Ralph (2012) by emphasizing evidence to suggest that demonstrations, taste-tests and practical activities used I addition to conventional teaching methods lead to a better overall knowledge outcome and more enthusiastic learners. Friedman, Cosby, Boyko, Hatton-Bauer & Turnbull (2010); Houts, Doak, Doak & Loscalzo (2006) and Johnson & Sandford (2005) also recommended that verbal education with the help of visual graphics were a lot more successful than the traditional means of education. Demonstrations showed the highest and most successful response to the education methods tested on the varios patients (Friedman *et al*; Houts *et al* 2006; Johnson & Sandford 2005). Ralph (2012); Doyle-Lucas & Davy (2011) and Perez-Rodrigo & Aranceta (2003) the further suggest that adolescents can then assess their own knowledge and understanding as well as that of family and friends and open discussions could be held throughout the teaching and learning process about current dietary habits and concerns or questions. The last approach to delivering nutrition education is to have peer-to-peer education programmes whereby the coach and athletes could meet in a small group on a regular basis. The advisor

could provide the athlete with individual nutritional requirements and provide advice to meet their needs and address their concerns. This method has proven to greatly enhance the adolescent athlete's interest in nutrition. Dieticians could be used in this instance to conduct such meetings. It should also be considered that athletes may respond better to someone of a similar age whom they can relate to (Ralph 2012; Kunkel, Bell & Luccia 2001).

Understanding the adolescent thought process and the most appropriate nutrition education methods for individuals in that stage of the life span, will enhance the quality of the information being given to scholars (Zinn *et al* 2006). Furthermore, it is also important to take cognisance of the factors that influence the behaviour and beliefs of adolescent athletes in order to enhance nutrition education. Zinn *et al* (2006) are of the opinion that coaches and parents are the primary source of nutrition information for adolescent athletes. It is proposed that including them in the education process of the adolescent athlete, will enhance education outcome in the long run. This may prove to be difficult, as parental time may be limited and could therefore serve as a barrier to their involvement (Zinn *et al* 2006). However, Zinn *et al* (2006) suggest including parents, even if it is by means of a take-home article that summarise key points covered in any one of the three education methods used. When it comes to coaches, nutrition education should form part of their job description, as it would improve overall health and performance of athletes in the short term and long run (Burkhart 2010; Zinn *et al* 2006, Juzwiak & Ancna-Lopez 2004).

2.9 Summary

It has been well established that nutrition is an essential part of an athlete's training and competing schedule. In the case of adolescent athletes and, for the purposes of this study, rugby players general- and- sports related nutrition knowledge is a vital component of overall performance during training or a match and for optimal future bodily health. Understanding how energy, macronutrients, fluid and electrolytes and supplement use can and will affect their performance and health is vital at this impressionable life stage. The knowledge and habits learnt from 11 to 21 years of age and their bodily health will be carried through with these young adults into adulthood. Due to the alarming increase in pressure to perform well in many South African schools

regarding rugby, specifically, there is no better time than the present to start nutrition education and awareness. An emphasis on the importance of accurate general- and-sports related nutrition knowledge among adolescent athletes, may improve performance and reduce the abuse of main stream and illegal substances at the start of their sporting careers. In order to develop an argument pertaining to the vitality of introducing nutrition education in the schooling curriculum there needs to be an understanding of what adolescent athletes know. Unfortunately there is a lack of current and accurate data in published journals regarding the stand-point of South African adolescent athletes and rugby players, specifically. This lead to the development of this cross- sectional study whereby a general- and- sports related nutrition knowledge questionnaire was used to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending a secondary urban government school in Pietermaritzburg, KwaZulu-Natal.

In Chapter 3, the materials and methods that were used to collect the data for this study will be discussed.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides an overview of the following aspects related to the study methodology, namely: (i) how the study was conducted; (ii) the study population and sample selection; (iii) methods and materials, including data collection methods and the development of the measuring instrument. The procedure for conducting the pilot study will also be discussed and the study variables, data capturing and statistical analysis will be presented. Finally, measures implemented to facilitate data quality control and reduction of bias as well as ethical considerations and obtaining ethics approval to conduct the study will be presented.

3.2 Study design

A cross-sectional descriptive study was conducted to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending an urban government school in Pietermaritzburg.

Mann (2003) explains that the advantages of a cross-sectional study are that it is:

- Cost-effective and simple to undertake;
- Can be conducted in a relatively short period of time;
- Requires limited resources;
- Used to help lead to the ‘why’ factor related to subject responses. The result from a cross-sectional study could later be used in a cohort study to further explain the prevalence found.

However, Mann (2003) also explains the disadvantages associated with this study design:

- An inability to find a definitive link between the results obtained and the reason they were obtained, as there may be many other factors that have influenced the study outcome;
- Difficulty in determining the degree of the condition/cause; and
- Increase in result bias due to an inadequate study sample size and/or response rate.

3.3 Study population and sample selection

3.3.1 Study population

The study population included male rugby players of all races attending a secondary urban government school in Pietermaritzburg. Day scholars as well as borders were eligible for participation.

3.3.2 Sample selection

Due to time and cost constraints, a large (N=1250) urban all-boys government school was conveniently chosen as the research cite for the following reasons: (i) Fourty percent (n=500) of the scholars participate in rugby as a winter sport; (ii) the school is multi-racial and therefore representative of the South African population; (iii) the school is known as one of the best rugby schools in KZN and therefore has a good reputation regarding their competitive rugby participation; and (iv) research of a different nature was previously conducted amongst scholars of the school. Hence, the headmaster, teachers and coaches have a positive relationship with UKZN and were willing to accommodate research that would prove to be advantageous to the school and its scholars. In addition to the above, the school was also selected because both the stronger and weaker players regularly participate in competitive matches.

3.4 Study methods and materials

3.4.1 Measuring instruments

A nutrition knowledge questionnaire developed for urban South African adolescents (Whati 2005) was adapted for the purpose of this study in relation to the study objectives reported in chapter one. In addition the researcher used literature published in peer reviewed journals to select additional, relevant questions that were included in the final questionnaire and added several sports-related nutrition knowledge questions. Additional questions from a master's dissertation by Strachan (2009) that investigated the perceptions and use of nutritional supplements by adolescent rugby players in KwaZulu-Natal, were also included. Other sports nutrition-related questions that were included were considered to be important as per peer reviewed literature. The final questionnaire comprised of 50 close-ended questions (see Appendix A) which was divided into three sections:

- Section A: 24 close-ended questions, with a true/false option, each comprising of a combination of general- and sports-related nutrition knowledge questions.

- Section B: 16 multiple choice questions that included a combination of general- and sports-related nutrition knowledge questions.

- Section C: 10 close-ended questions and 2 close-ended sub-questions, each that came with instructions on how to answer the specific question. This section of the questionnaire covers aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing.

Table 3.1 provides an overview of the peer reviewed literature that was used to select each question and justify the reason for each choice.

Table 3.1 Table depicting the literature-based choice of questions for the general- and sports-related knowledge based questionnaire.

Number	Question	Reason of choice	Related literature
Section A			
1.	You should eat a lot of sugar to have enough energy.	Sugar consumption as a form of carbohydrate, varies based on the gender of the athlete, total amount of kilojoules expended, the particular sport and the location.	Rodriguez, DiMarco & Langly (2008).
2.	You should add extra salt to your cooked food before you even eat it.	There is a direct relationship between an increase in salt consumption and raised blood pressure levels, irrespective of whether hypertension is present or not.	Wentzel-Viljoen, Steyn, Ketterer & Charlton (2013).
3.	If you are eating a healthy diet, there is no need for you to be physically active.	Physical activity assists the body by using the kilojoule intake through food to maintain an energy balance.	Botha & Wright (2013)
4.	All water is safe to drink.	Regardless of the number of water maintenance standards in South Africa; water quality in this country remains a volatile problem.	Van Graan, Bopape, Phooko, Bourne & Wright (2013).
5.	Your body only needs a little bit of salt to be healthy.	In South Africa salt is iodated. Thus consuming the recommended amount is necessary. However, it is also important not to consume salt in excess due to the various health problems associated with this practice.	Wentzel-Viljoen *et al* (2013).
6, 8 & 12	6. Sugar and foods that contain sugar should be eaten in small amounts. 8. Sugar contains a lot of vitamins and minerals. 12. It is healthy to snack on foods that contain a lot of sugar.	"Use food and drinks containing sugar sparingly, and not between meals". Sugar has little to no micronutrient value. Thus a high-sugar diet could mean depleted micronutrient stores. "Use food and drinks containing sugar sparingly, and not between meals".	Temple & Steyn (2013).
7 & 9	7. Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods. 9. It is impossible to get all the vitamins and minerals you need from food, you need to take a vitamin and mineral pill.	A well-balanced diet will provide adequate water, energy, macro and micro-nutrients.	Steyn (2013).

10 & 11	10. Starchy foods should not be eaten when one is trying to lose weight. 11. Eating bread always causes weight gain.	There are a number of contradictory studies regarding this matter. However, this review paper suggests that reducing the total energy intake as opposed to carbohydrates in particular, could be the best method of weight-loss. Low carbohydrate diets are also very difficult to adhere to.	Vorster (2013).
13, 14 & 16	13. Dry beans, peas, and lentils should be eaten often. 14. Soya mince is as healthy as meat. 16. Dry beans, peas, lentils are a healthy choice to eat in place of meat.	"Eat dry beans, split peas, lentils and soya regularly" Soya and beans are high in fibre, low in fat, contain a valuable source of protein and contain no saturated fatty acids. As meat is high in saturated fatty acids, substituting meat with pulses and soya may improve overall health by reducing the risk of type 2 diabetes and heart disease.	Venter, Vorster, Ochse & Swart (2013).
15.	You can eat as much meat as you want everyday	560g meat (about 80-90g per day) should be consumed on a weekly basis.	Schonfeldt & Hall (2013).
17 & 18	17. I supplement my diet with food items/ alternatives. 18. It is necessary to supplement your diet (use supplements) to build muscle mass.	Globally, supplement usage figures are between 40 and 88 percent. Supplements prescribed by an unreputable source can be dangerous and harmful to the body. They are costly and there is no sound evidence regarding their benefits.	Molinero & Márquez (2009).
19 & 20	19. Fats are necessary in your diet as they provide additional energy and fat soluble vitamins. 20. Your food could contain good- and bad fats.	In order to maintain energy balance in the body, fat needs to be consumed, as it is a major contributor to energy intake. There are also many vital fatty acids that will be consumed through an adequate fat intake. Mono- and poly-unsaturated fatty acids are more beneficial to health than saturated fatty acids.	Smuts & Wolmarans (2013).
21 & 26	21. Pre-workout meals/ drinks should contain carbohydrates. 26. Post workout meals/ drinks should contain carbohydrates.	Maintenance of blood glucose during a match is of vital importance. Hence, a high carbohydrate pre-competition snack is important. Carbohydrate containing meals after exercise are necessary to replace glycogen lost during exercise and to help muscle recovery.	Rodriguez *et al* (2008).

22 & 23	22. Caffeinated energy drinks are necessary for an energy boost before practice or a game. 23. There is a difference between a sport drink and an energy drink.	Studies have proven the benefits of caffeine in aerobic activity. However, the benefits are achieved through very specific doses and the effects have not yet been studied on children or adolescents. The words sports drinks and energy drinks do not account for the same thing and should not be used interchangeably.	Schneider & Benjamin (2011).
24.	My diet changes between pre, during and post season.	Conditioning of the rugby player, which includes diet, undergoes necessary changes pre, during and post season.	Smit (2012).
25.	What I eat, affects my performance, recovery and body composition more than additional supplements.	If a well-balanced diet is consumed, additional supplementation with vitamins and minerals is not necessary. However, this does change if athletes have poor eating habits, omit certain foods, follow a weight-loss programme and consume foods with a poor micronutrient content.	Rodriguez *et al* (2008).
Section B			
1.	You should not have starches at most meals because…	"Make starchy foods part of most meals"	Vorster (2013).
2.	How much water should you drink a day?	The recommended amount is between 2 and 3.7 litres per day	Van Graan *et al* (2013).
4.	Which of the following is a low fat snack.	High saturated fatty acid intakes can raise the overall risk of heart disease. The intake of saturated fatty acids has increased through a western style of eating.	Smuts & Wolmarans (2013).
5 & 6	5. From which group of foods should you eat the most every day? 6. The key to a healthy way of eating is to…	Overall, it is important to eat a variety of foods that provide adequate energy while reducing the overall saturated fat and sugar intake. Healthy eating is achieved by consuming adequate water, sufficient energy and macro and micro-nutrients.	Steyn (2013).
7.	Which foods contain a lot of calcium?	South Africa has revised the food based dietary guidelines and added a guideline related to milk, maas and yogurt. This was decided after research showed a low calcium intake among South Africans. Appropriate calcium intake is vital for adolescents as it contributes to adequate and appropriate bone growth and maturation ensuring bone health (prevention of osteoporosis) later in life.	Vorster, Wright, Wentzel-Viljoen (2013) and Gao, Wilde, Lichtenstein, Tucker (2006)
8.	The healthiest snack is…	If regular, healthy meals are consumed it could reduce the total daily snacking on energy and fat dense foods	Gunes, Bekiroglu, Imeryuz, Agirbasli (2012).
9.	Being physically active means…	For adolescents, moderate to intense exercise for at least 60 minutes a day is vital for overall health.	Botha, Wright (2013).

10.	How many fruits and vegetables should be eaten on a daily basis?	Eating plenty of vegetables and fruit everyday will contribute to lowering the overall risk of lifestyle diseases in adulthood. 400g of vegetables and fruit, daily, are recommended for adolescents and adults.	Naude (2013)
11.	How much milk or maas should be consumed per day?	Drinking milk will provide good quality protein, calcium and numerous essential amino acids.	Vorster *et al* (2013).
12.	A well- balanced diet consists of:	Numerous vitamins and minerals are required for bodily health. These cannot be consumed through only one type of food. Thus variety and balance is important	Steyn (2013).
13.	Which of the following breakfast menus contain little fat…	Adolescents should aim to eat ready-to-eat cereals low in fat, added sugars, high in fibre, complex carbohydrates and vitamins and minerals. Consuming cereals will also help contribute to the calcium intake through milk consumption.	Deshmukh-Taskar, Nicklas, O'neil, Keast, Radcliffe & Cho (2010) and Whittaker, Tufaro & Rader (2001).
14.	Which food has the most fibre?	Fibre is not only beneficial to the gut, but fibre-containing foods can provide the body with energy.	Vorster (2013).
15.	The reason why beans, peas and lentils are good for you is that…	Beans are high in fibre, low in fat, contain a valuable source of protein and contain no saturated fatty acids.	Venter *et al* (2013).
16.	It is important to stay hydrated…	Water is vital for health and survival.	Van Graan *et al* (2013).
7.	The following energy drinks contain caffeine…	The possible adverse effects of caffeine on the body have brought to light the concerns regarding the caffeine content in energy drinks.	Reissiga, Straina, Griffiths (2009).
Section C			
1, 2, 3, 4	1. What is your source of nutrition information? 2. Do you use sports- or nutritional supplements? 3. Would you consider taking an illegal supplement if it would improve your sporting performance or help you achieve your goals? 4. Have you made changes to your diet to help you achieve your goals?	Before any nutritional, supplement and any other programmes can be created and implemented to assist adolescent athletes it is vital to understand what they know an where they get their information from. There has been an increase in popularity of nutritional supplements in the last few years. These have shown negative health and economic-related problems in current and future lives of these adolescent athletes. In South Africa a major problem in the eyes of health professionals, is the lack of regulation on the supplement industry. It has been proven that if a well-balanced diet that includes all the food groups is consumed, additional supplementation may not be necessary.	Gradidge, Coopoo, Constantinou (2010) and Strachan (2009)

5.	Rate on a scale from 1-5 how important you think each of the following is in helping you to achieve your goals	A successful athletes needs to be well rounded in terms of nutrition knowledge, education and sport physiology.	Rodriguez, DiMarco & Langly (2009).
6.	Do you think the carbohydrate-rich foods you eat before, during or after training can affect your performance?	Sufficient and appropriate energy needs to be consumed during sporting periods to ensure current and future health and weight safety of the adolescent's body and maximum sporting output.	Rodriguez *et al* (2008).
7.	When is it most important to eat carbohydrate rich foods?	Sufficient intakes of macronutrients and maintaining hydration status is vital before, during and after exercise. Carbohydrates contribute to the overall energy input for rugby players and play a role in maintaining blood glucose levels and improving recovery after exercise.	Rodriguez (2012); Burke *et al* (2011); Ferguson-Stegall *et al* (2011) and Rodriguez *et al* (2009)

3.5 Pilot study

The questionnaire was piloted on 5% (n=6) of the study population after they completed and signed the informed consent form and the instructions for completing the questionnaire were read out to them. The pilot study subjects that participated were selected by the Director of Rugby of the school that was used to conduct the survey used in the study. One member from each age category were selected and only those that showed up at the time of conducting the pilot study took part in the pilot study. Subjects that participated in the pilot study with a duration of 20 to 30 minutes, did not participate in the main study. After assessing the data generated by the pilot study, the primary investigator adjusted the questionnaire. These changes and the reasons for their implementation are reported in Table 3.2 below.

Table 3.2 Changes that were made to the questionnaire as a result of the pilot study.

Section Question number	**Original question**	**Post pilot change**	**Reason**
Section A Q 13	Dry beans, peas, and lentils should be eaten often.	Removed from questionnaire	One question on dry beans, peas, and lentils was considered to be adequate.
Section A Q 14	Soya mince is as healthy as meat	Removed from questionnaire	This question was considered to be ambiguous. It is not necessarily as healthy but is considered to be healthy, just as meat it too.
Section B Q 7	The healthiest snack is:	Removed from questionnaire	A very similar question was asked in section B, Q 3 "Which of the following is a low fat snack?"
Section C Q 3	Would you consider taking a supplement (that may be banned and/or have negative side-effects) if it would improve your sporting performance or help you achieve your goals?	Would you consider taking a non-food supplement if it would improve your sporting performance or help you achieve your goals?	Upon conducting the pilot study the rugby director of the school suggested that in order to get more honest responses the question should be re-worded to sound less serious.
Section C Q 7	When is it important to eat carbohydrate rich foods?	Question moved to question 10 in Section C	The change was due to the addition of new questions.
Section C Q 7	Question was not present in original questionnaire.	Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure?	This question was added to reiterate the findings of question 3 in section C which was re-worded. Strachan (2009) supports the addition of a question of this nature.
Section C Q 8	Question was not present in original questionnaire	Are you using a pre-workout supplement?	This question was added upon request of the rugby director during the pilot study as it was felt that due to the increased popularity of these products, it would be of interest to determine how many players are using them. Strachan (2009) supports the addition of a question of this nature.
Section C Q 9	Question was not present in original questionnaire	If so, what is the name and brand of the pre-workout	Question was added for the rugby director to have a better idea of the products

		supplement being used?	being used by scholars. The primary investigator was of the opinion that the addition of this question would generate data that could be valuable when educating the scholars in relation to the findings of the current study.

3.6 Data collection

All eligible subjects were invited to participate in the study by their relevant coaches. Those that arrived for participation at the time/date set aside for data collection, completed an informed consent form (See Appendix B1 and B2) before they participated in the survey. Data was collected over a two day period under test conditions, i.e. subjects were seated at individual desks in a large hall and asked not to communicate with each other while completing the questionnaire. All teams were invited to complete the questionnaire on a Friday afternoon after school as per the coaches' request, so that it did not interfere with school work, practice or playing time. Due to the fact that exams were in progress at the time of data collection, all eligible subjects were not were not able to participate on the first day of data collection. As a result, a second data collection session was planned to enable optimal subject participation.

As subjects under the age of 14 were not legally allowed to consent to participation, the consent form was emailed to their parents by the director of rugby at the school. The parents then signed the forms and faxed them back to the school before data collection took place. For subjects 14 years and older, informed consent forms were collected whilst the participants were completing the questionnaire and were kept separate from the questionnaire to ensure that subject anonymity was ensured. Before subjects started completing the questionnaire, the instructions were read out to them and they were asked to complete their socio-demographic information. The researcher was available to attend to questions or queries throughout the data collection process and monitor communication between subjects. On completion of the questionnaire, the researcher paged through each questionnaire to ensure that every question was

answered as per the stipulated instructions. Subjects then received a lollipop as a token of appreciation.

3.7 Variables included in the study, data capturing and statistical analysis

Table 3.3 below will indicate the statistical analysis done to achieve each study objective.

Table 3.3: Analysis of data to determine each study objective

Study objective	**Corresponding variables**	**Statistical analysis**
To determine the general- and sports-related nutrition knowledge and trends of male adolescent rugby players	• Nutrition knowledge and trends • Male adolescent rugby players	• Descriptive statistics e.g. Frequency distributions • Independent samples t-tests • Chi square test to determine statistical significance of nutrition knowledge between study variables
To compare the general- and sports-related nutrition knowledge and trends of the forward and backline players	• Nutrition knowledge and trends • Player position	• Descriptive statistics e.g. Frequency distributions • Independent samples t-tests • Binary logistic regression analysis • Chi square test to determine statistical significance between study variables and player positions
To compare the general- and sports-related nutrition knowledge and trends of male adolescent rugby players in each age group; under 14, under 15; under 16 and open	• Nutrition knowledge and trends • Under 14 to open age groups	• Descriptive statistics e.g. Frequency distributions • Independent samples t-tests • Chi square test to determine statistical significance between study variables and age groups
To compare the general- and sports-related nutrition knowledge and trends of the open age group to the non-open age category	• Nutrition knowledge and trends • Open age group and other three age groups	• Descriptive statistics e.g. Frequency distributions • Binary logistic regression analysis • Chi square test to determine statistical significance between study variables and open age group compared to the other three age groups
To determine whether there is a progression/ improvement in nutrition knowledge from the under 14 age group to the open age group	• Progression/ improvement • Under 14 to open age groups	• Descriptive statistics e.g. Frequency distributions • Independent samples t-tests • Chi square test to determine statistical significance between study variables and age groups

The data was analysed using the Statistical Package for Social Sciences (SPSS) version 21 (Chicago 2012) and evaluated with a statistical significance at a probability of <0.05. Four tests were done to analyse the results namely; descriptive statistics to determine frequency distributions, chi square test to determine statistical significance, independent samples t-test to compare continuous data between categories and binary logistic regression analysis to determine the relationship between two variables.

3.8 Data quality control

3.8.1 Reliability and validity

3.8.1.1 Reliability

Drost (2011); Babbie & Mouton (2008) and Katzenellebogen & Joubert (2007) suggest that the concept of reliability is the ability to obtain the same results each time for an object to which a specific technique is applied by numerous different people. Whati, Senekal, Steyn, Nel, Lombard & Norris (2005) and Miller (1989) highlight that the reliability of a questionnaire can be determined using the Cronbach alpha (α) a reliability coefficient (between 0 and 1). A questionnaire that scores a reliability coefficient closer to one would be more reliable than one calculated closer to 0 (Whati *et al* 2005; Miller 1989).

Reliability in the current study was achieved and maintained through the assembling and constructing the questionnaire with reference to the relevant published literature. Majority of the questions used in the questionnaire were taken from Whati (2005) and Strachan (2009). Table 3.1 above shows the literature justification for each question being used. Thus there was a scientifically sound reason for selecting and asking each particular question. Whati 2005 successfully developed and tested a general nutrition knowledge questionnaire for South African adolescents in the urban sector. A number of steps were taken to ensure the internal consistency reliability of Whati (2005)'s questionnaire. The results of the questionnaire indicated an acceptable cronbach alpha value of 0.7 for both the schools tested (Whati 2005). The questionnaire was pilot tested and only questions that remained within the difficulty index of 0.1-0.9 were used in the questionnaire; the others were removed for being too difficult or too easy (Whati 2005). Further, questions in relevant sections that resulted in the cronbach α being reduced were removed to maintain the adequate 0.7 (Whati 2005). According to Whati (2005) the Kruskal-Wallis rank order test was also used to enable the result of the questionnaire to be distinguished between the different levels of understanding and knowledge between the different groups. (Whati 2005). The questionnaire developed by Strachan (2009) was designed to be used as a survey to better understand the use of nutritional supplements and adolescent sportsmen. Strachan

(2009) conducted a pilot test on her questionnaire to ensure its reliability and published a paper on the questionnaire used and results obtained. The combination of the two questionnaires to produce the general- and sports-related nutrition knowledge used in the current study was also pilot tested on 5% of the total sample of male adolescent rugby players at the urban, secondary, government school. These boys did not partake in the final data collection process. Table 3.2 above indicates the questionnaire filtering that took place in order to obtain the final questionnaire for data collection. Further reliability in the current study was managed through training of the fieldworkers on the process of data collection; the questionnaires were thoroughly read through after the data collection was conducted to ensure they were all valid; the primary investigator was present during the data collection process to answer questions and avoid confusion and to ensure test conditions (no talking or viewing other questionnaires by participants) were maintained. Finally the results were triple checked by the primary investigator before being sent for analysis and re-checked by the statistical supervisor before analysis.

3.8.1.2 Validity

Drost (2011); Babbie & Mouton (2008); van der Riet & Durrheim (2008) and Katzenellebogen & Joubert (2007) all advocate that validity refers to the level of accuracy, consistency, meaningfulness and relevance of the research being conducted. The investigator needs to ensure that the results found represent the objectives set out at the start of the study (Drost 2011; Babbie & Mouton 2008; van der Riet & Durrheim 2008; Katzenellebogen & Joubert 2007).

Whati (2005) used a number of methods to obtain validity regarding the questionnaire being designed in the study. The difficulty index and Cronbach α value were assessed and the questionnaire was adjusted accordingly. It must be remembered, however, that the difficulty index and Cronbach α are not a true measure of validity but rather of reliability thus additional methods of determining validity needed to be undertaken (Whati 2005). Thus the construct validity (ensuring that the questionnaire could measure the overall knowledge of different participants) was developed and ensured. In order to do this Whati (2005) used a control group with expert (has knowledge regarding nutrition) and non- expert (has no knowledge regarding nutrition) to

complete the questionnaire. Finally they also managed the age distribution of the control group to ensure the questionnaire accounted for its target market (adolescents) (Whati 2005). According to Whati (2005) the validity of the questionnaire was then re-assessed later on by three experts in the field: (i) the items on the questionnaire were grouped in order to assess whether they met the initial objectives and criteria decided upon. Of the objects that were repeated, the most appropriate one was reserved; (ii) the second means of assessing validity was done by checking whether each item in the questionnaire covered the overall objectives and sections that needed to be covered to obtain the required results (Whati 2005). Both Strachan (2009) and Whati (2005) used tried and tested methods of data entry and statistical packages. Strachan (2009) used Statistica 8 and Microsoft Excel XP, whilst Whati (2005) used SAS system for windows, version 8.2. In the current study the results were assessed and filtered using standardised data entry methods before being entered into the Statistical Package for Social Sciences (SPSS) version 21 (2012). The statistical analyses were done according to the study objectives thus maintaining the value of the work as the objective results were achieved. Regardless of the small sample size statistical conclusion validity (the identification of two variables in the study Drost 2011) was seen. There was a relationship between the general- and sports-related nutrition knowledge and the male adolescent rugby players; between the general- and sports-related nutrition knowledge and the player position and between the general- and sports-related nutrition knowledge and the age groups. This meant that internal validity (representation of the relationship of the data obtained Drost 2011) was not defined as causal as the results obtained were through a convenience sample and not a bias sample.

Overall it can be seen that the original questionnaires used in order to obtain the questionnaire relevant to the current study maintained a good standard of reliability ad validity. It can also be seen that the methods of the current study are concurrent with the methods needed to assume that reliability and validity were achieved and maintained throughout the research project.

3.9 Ethical considerations

Ethics approval to conduct this study was obtained from the ethics committee of Humanities and Social Sciences Ethics Research Committee at UKZN (HSS/0066/012PGD) (see Appendix C) after the school also issued the researcher with a letter giving gatekeepers permission to conduct the study on the scholars (see Appendix D). All questionnaires were completed anonymously after participants completed and signed a letter of informed consent (see Appendix B1 and B2). Due to the fact that the informed consent forms contained the subject's signatures, they were not attached to the questionnaire that served as the data collection tool. This ensured that subject anonymity was ensured. During the explanation of the instructions that had to be adhered to when completing the questionnaire, verbal permission was obtained to use the photographs taken during the data collection process.

All the questionnaires that will be locked in a secure space behind a Trellidoor (Room B1) at Dietetics and Human Nutrition, School of Agricultural, Earth and Environmental Sciences, Pietermaritzburg Campus (UKZN) for a period of five years after the completion of the study. After the five year period has lapsed, questionnaires will be shredded and disposed of.

3.10 Summary

A cross-sectional descriptive study was conducted to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending an urban government school in Pietermaritzburg. The study population included male rugby players of all races attending a secondary urban government school in Pietermaritzburg. Day scholars as well as borders were eligible for participation. Due to time and cost constraints, a large (N=1250) urban all-boys government school was conveniently chosen as the research cite. A nutrition knowledge questionnaire developed for urban South African adolescents (Whati 2005) was adapted for the purpose of this study in relation to the study objectives reported in chapter one. In addition the researcher used literature published in peer reviewed journals to select additional, relevant questions that were included in the final questionnaire and added several sports-related nutrition knowledge questions. Additional questions from a

master's dissertation by Strachan (2009) that investigated the perceptions and use of nutritional supplements by adolescent rugby players in KwaZulu-Natal, were also included. Other sports nutrition-related questions that were included were considered to be important as per peer reviewed literature.

The final questionnaire comprised of 50 close-ended questions (see Appendix A) which was divided into three sections comprising of: true/false questions, multiple choice questions and aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing. The questionnaire was piloted on 5% (n=6) of the study population Subjects that participated in the pilot study did not participate in the main study. After assessing the data generated by the pilot study, the primary investigator adjusted the questionnaire. Data was collected over a two day period under test conditions. Due to the fact that exams were in progress at the time of data collection, all eligible subjects were not were not able to participate on the first day of data collection. Reliability and validity was maintained in numerous ways throughout the study and the data was analysed using the Statistical Package for Social Sciences (SPSS) version 21 (Chicago 2012).Ethics approval to conduct this study was obtained from the ethics committee of Humanities and Social Sciences Ethics Research Committee at UKZN.

In chapter four which follows, the results of the study will be presented in accordance with the study objectives that were presented in chapter one.

CHAPTER 4: RESULTS

4.1 Introduction

In this chapter the results of the current study will be reported in accordance with the study objectives that were set in chapter one.

4.2 Results

4.2.1 Characteristics of study sample

Table 4.1 presents the socio-demographic characteristics of the study sample as well as other relevant variables to describe the study sample.

Table 4.1: Characteristics of study sample (N=110)

Variable	Standard Deviation/ % (n)
Age (years): Mean ± std. deviation	15.2 ± 1.4
Race:	
• White	78.9% (n=86)
• African	19.3% (n=21)
• Indian	0.9% (n=1)
• Coloured	0.9% (n=1)
Accommodation:	
• Boarder	70.1% (n=75)
• Day scholar	29.9% (n=32)
Team:	
• First	10.0% (n=11)
• Second	2.7% (n=3)
• Third	8.2% (n=9)
• Fourth	4.5% (n=5)
• Under 16A	6.4% (n=7)
• Under 16B	7.3% (n=8)
• Under 16C	1.8% (n=2)
• Under 15A	9.1% (n=10)
• Under 15B	10.0% (n=11)
• Under 15C	11.8% (n=13)
• Under 15D	10.9% (n=12)
• Under 14A	9.1% (n=10)
• Under 14B	4.5% (n=5)
• Under 14C	3.6% (n=4)
Position in the team:	
• Flank	16.4% (n=18)
• Lock	15.5% (n=17)
• Prop	12.7% (n=14)
• Wing	10.0% (n=11)
• Hooker	9.1% (n=10)
• Scrumhalf	7.3% (n=8)
• Inside centre	7.3% (n=8)
• Fullback	7.3% (n=8)
• Flyhalf	5.5% (n=6)
• Outside centre	4.5% (n=5)
• Eighth man	3.6% (n=4)
• Loose forward	0.9% (n=1)

From table 4.1 above, it is clear that the mean age (15.2 years) can be attributed to the fact that the majority of the sample size played in the under 16 age category, nearly 80% of the participants were white and more than two thirds were boarders. It is also evident that the under 15C team had the highest participation rate, whilst the under

16C team had the lowest. The majority of participants were flanks while loose forwards were in the minority.

4.2.2 General- and sports-related nutrition knowledge

Table 4.2 depicts the general- and sports-related nutrition knowledge of participants in relation to the response options provided in the true and false section of the questionnaire.

Table 4.2: General- and sports-related nutrition knowledge generated from the true/false section of the nutrition knowledge questionnaire (N=110)

Question	% (n)
You should eat a lot of sugar to have enough energy: • False • True	 87.3% (n=96) 12.7% (n=14)
You should add extra salt to your cooked food before you eat it: • False • True	 86.3% (n=88) 13.7% (n=14)
If you are eating a healthy diet, there is no need for you to be physically active: • False • True	 96.4% (n=106) 3.6% (n=4)
All water is safe to drink: • False • True	 91.8% (n=101) 8.2% (n=9)
Your body only needs a little bit of salt to be healthy: • True • False	 76.4% (n=84) 23.6% (n=26)
Sugar and sugar-containing foods should be eaten in small amounts: • True • False	 87.3% (n=96) 12.7% (n=14)
Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods: • True • False	 60.9% (n=67) 39.1% (n=43)
Sugar contains a lot of vitamins and minerals: • False • True	 83.6% (n=92) 16.4% (n=18)
It is impossible to get all the vitamins and minerals you need from food. You need to take a vitamin and mineral pill: • False • True	 75.5% (n=83) 24.5% (n=27)
Starchy foods should not be eaten when one is trying to lose weight: • True • False	 53.2% (n=58) 46.8% (n=51)
Eating bread always causes weight gain: • False • True	 61.8% (n=68) 38.2% (n=42)
It is healthy to snack on foods that contain a lot of sugar: • False • True	 85.5% (n=94) 14.5% (n=16)
You can eat as much meat as you want every day: • False • True	 66.4% (n=73) 33.6% (n=37)
Dry beans, peas, lentils are a healthy choice to eat instead of meat:	

• True • False	 59.3% (n=64) 45.8% (n=46)
I supplement my diet with food items/ alternatives: • False • True	 53.6% (n=59) 46.4% (n=50)
It is necessary to supplement your diet (use supplements) to build mass: • False • True	 71.8% (n=79) 28.2% (n=31)
Fats are necessary in your diet as they provide additional energy and vitamins: • True • False	 88.2% (n=97) 11.8% (n=13)
There is a difference between good and bad fats in food: • True • False	 90% (n=99) 10% (n=11)
Pre- workout meals/ drinks should contain carbohydrates: • True • False	 77% (n=84) 22% (n=24)
Caffeinated energy drinks are necessary for an energy boost before practice or a game: • False • True	 83.4% (n=91) 16.5% (n=18)
There is a difference between a sports drink and an energy drink: • True • False	 75.5% (n=83) 24.5% (n=27)
My diet changes between pre, during and post season: • False • True	 51.3% (n=56) 48.6% (n=53)
What I eat affects my performance, recovery and body composition more than additional supplements: • True • False	 78.9% (n=86) 21.1% (n=23)
Post workout meals/ drinks should contain carbohydrates: • True • False	 64.8% (n=70) 35.1% (n=38)

From the above results it is evident that study participants have an adequate general- and sports-related nutrition knowledge, as 95% of the general- and sports-related nutrition knowledge questions were answered correctly (there were two questions regarding personal supplement usage habits that were not included in obtaining this result as these are not related to the general- and sports-related nutrition knowledge of the participants).

More than 50% of the participants answered the question regarding carbohydrates and weight loss incorrectly, suggesting that knowledge regarding carbohydrate intake are a cause for concern. Less than half the participants (45.5%) used a supplement in addition to their diet. Less than half the participants also stated that their diets do not change between seasons.

Table 4.3 depicts the general- and sports-related nutrition knowledge of participants in relation to the response options provided in the multiple choice section of the questionnaire.

Table 4.3: General- and sports-related nutrition knowledge generated from the multiple-choice section of the nutrition knowledge questionnaire (N=110)

Question	% (n)
You should not have starches at most meals because:	
• None of the above	53.7% (n=58)
• Cause weight gain	30.5% (n=33)
• Not important for health	11.1% (n=12)
• Cause disease	4.6% (n=5)
How much water should you drink a day?	
• 7-9 glasses	50.0% (n=55)
• 4-6 glasses	42.7% (n=47)
• 1-3 glasses	5.5% (n=6)
• Don't have to drink water everyday	1.8% (n=2)
Which of the following is a low fat snack:	
• Popcorn	72.7% (n=80)
• Niknaks	15.5% (n=17)
• Simba chips	7.3% (n=8)
• Fried chips	4.5% (n=5)
From which food group should you eat the most every day?	
• Chicken, fish, beans, eggs	45.9% (n=50)
• Apple, banana, spinach, carrots	43.1% (n=47)
• Bread, samp, rice, porridge	9.2% (n=10)
• Milk, yogurt, cheese	1.8% (n=2)
Key to healthy eating is to:	
• All of the above	51.8% (n=57)
• Certain foods in small/ moderate amounts	29.1% (n=32)
• Many different kinds of foods	10.0% (n=11)
• Some foods more than others	9.1% (n=10)
Which foods contain a lot of calcium?	
• Milk, yogurt	64.2% (n=70)
• Chicken and eggs	30.3% (n=33)
• Pilchards	2.8% (n=3)
• Milk, yogurt and pilchards	2.8% (n=3)
Being physically active means:	
• all of the above	94.5% (n=104)
• playing sports	4.5% (n=5)
• going to gym	0.9% (n=1)
How many fruits and vegetables should be eaten on a daily basis	
• 3-4/ day	62.4% (n=68)
• More than 5/ day	24.8% (n=27)
• 1/ day	11% (n=12)
• No need to eat fruit and veg daily	1.8% (n=2)
How much milk or maas should be consumed per day?	
• 1 cup	46.8% (n=51)
• 2 cups	41.3% (n=45)
• Half a cup	8.3% (n=9)
• None	3.7% (n=4)

A well balanced diet consists of:	
• Mostly meat	38.9% (n=42)
• Mostly veg	33.3% (n=36)
• None of the above	14.8% (n=16)
• Mostly starch, veg and fruit	13% (n=14)
Which of the following breakfast menus are low in fat?	
• Weet-bix with 2% milk and whole-wheat toast with little margarine	53.2% (n=58)
• Weet-bix with 2% milk	
• Bacon and egg	28.4% (n=31)
• Whole-wheat toast with little margarine	12.8% (n=14)
	5.5% (n=6)
Which food contains the most fibre?	
• Whole-wheat bread	62.6% (n=67)
• Brown bread	19.6% (n=21)
• What is fibre?	10.3% (n=11)
• White bread	7.5% (n=8)
The reason why beans, peas and lentils are good for you is that:	
• All of the above	57.8% (n=63)
• Contain little fat	21.1% (n=23)
• Contain high fibre	15.6% (n=17)
• Can protect from disease	5.5% (n=6)
It is important to stay hydrated:	
• Before, during and after exercise	80.9% (n=89)
• During and after exercise	10.9% (n=12)
• After exercise	7.3% (n=8)
• During exercise	0.9% (n=1)
The following energy drinks contain caffeine:	
• All of the above	91.7% (n=99)
• Red bull	5.6% (n=6)
• Monster	2.8% (n=3)
Correct beverage to drink during a workout is:	
• Powerade	89.9% (n=98)
• Coca Cola	5.5% (n=6)
• All of the above	3.7% (n=4)
• Monster	0.9% (n=1)

Table 4.3 reiterates the findings depicted in table 4.2, whereby study participants showed an adequate general- and sports-related nutrition knowledge (62.5% of the questions were answered correctly). The remaining 37.5% of the questions that were answered incorrectly indicate that participants lacked knowledge regarding carbohydrates, protein and an understanding of what a well-balanced diet and healthy eating entails. Fifty one point eight percent (51.8%) of the participants chose “all of the above” as their preferred answer to the question that assessed knowledge regarding what healthy eating entails. Only 2.7% of the participants knew that pilchards are a good source of calcium.

Table 4.4 depicts the general- and sports-related nutrition knowledge of participants in relation to the response options provided in the final section of the questionnaire; which covers: aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing.

Table 4.4: General- and sports-related nutrition knowledge generated from the final section of the questionnaire (N=110)

Question	**% (n)**
Source of nutrition information (more than one option could be chosen):	
• Parents	54.5% (n=60)
• Media	46.4% (n=51)
• School	40.9% (n=45)
• Peers/ friends	31.8% (n=35)
• Other	13.6% (n=15)
Do you use nutritional supplements?	
• Yes	57.8% (n=63)
• No	42.2% (n=46)
Frequency of supplement use:	
• 3-4 times a week	27.0% (n=17)
• Daily	22.2% (n=14)
• Once or twice a week	20.6% (n=13)
• Less than weekly	19.9% (n=12)
• Once a week	11.1% (n=7)
Most frequently used supplement (more than one option could be chosen):	
• Protein shake	38.2% (n=42)
• Energy drinks	19.1% (n=21)
• Meal replacements	10.9% (n=12)
• Mass builder	9.1% (n=10)
• Creatine	8.2% (n=9)
• Fat burner	6.4% (n=7)
• Amino acids	5.5% (n=6)
• Other	5.5% (n=6)
• Taking one but unsure what it is	1.8% (n=2)
Have you ever considered taking a non-food supplement to improve sporting performance or help achieve goals?	
• Yes	63.5% (n=66)
• No	36.5% (n=38)
Have you ever considered changing your diet to help achieve goals:	
• Yes	

• No	68.6% (n=72) 31.4% (n=33)
Dietary changes made (more than one option could be chosen):	
• Healthier food choices, no junk food	52.7% (n=58)
• Increased protein portions	48.2% (n=53)
• More vegetables and fruit	40.9% (n=45)
• Decreased carbohydrate portions	22.7% (n=25)
• Cut out snacking between meals	21.8% (n=24)
• Increased carbohydrate portions	20.0% (n=22)
• Planned snacks around exercise	17.3% (n=19)
• Included snacks between meals	3.6% (n=4)
• Other	1.8% (n=2)
• Decreased protein portions	0.9% (n=1)
Rate the importance of exercise or practice sessions to your overall performance:	
• Critical, can't achieve without it	67.9% (n=74)
• Very important	25.7% (n=28)
• Fairly important	3.7% (n=4)
• Helps a little	2.8% (n=3)
Rate the importance of gym or weight training to your overall performance:	
• Very important	38% (n=41)
• Fairly important	32.4% (n=35)
• Critical, can't achieve without it	13% (n=14)
• Helps a little	13% (n=14)
• Not important	3.7% (n=4)
Rate the importance of diet/ what you eat to your overall performance:	
• Critical, can't achieve without it	46.8% (n=51)
• Very important	35.8% (n=35)
• Fairly important	11% (n=12)
• Helps a little	5.5% (n=6)
• Not important	0.9% (n=1)
Rate the importance of rest to your overall performance:	
• Critical, can't achieve without it	52.7% (n=58)
• Very important	26.4% (n=29)
• Fairly important	13.6% (n=15)
• Helps a little	4.5% (n=5)
• Not important	2.7% (n=3)
Rate the importance of supplements to your overall performance:	
• Not important	33.9% (n=37)
• Helps a little	30.3% (n=33)
• Fairly important	18.3% (n=20)
• Very important	16.5% (n=18)
• Critical, can't achieve without it	0.9% (n=1)
Can carbohydrate-rich foods eaten before, during or after training affect performance?	
• Yes	56.5% (n=61)
• I don't know	32.4% (n=35)
• No	11.1% (n=12)

Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure?	
• No	90.7% (n=97)
• Yes	9.3% (n=10)
Are you using a pre-workout supplement?	
• No	80.7% (n=88)
• Yes	19.3% (n=21)
Pre-workout supplement brand:	
• I don't know	14.3% (n=3)
• Whey powder	14.3% (n=3)
• No-name brand	9.5% (n=2)
• Evox	9.5% (n=2)
• Beast mode	9.5% (n=2)
• ECA-stack	4.8% (n=1)
• Ensure	4.8% (n=1)
• ECA	4.8% (n=1)
• Gaterade	4.8% (n=1)
• Boot extreme	4.8% (n=1)
• USN explode	4.8% (n=1)
• USN	4.8% (n=1)
• Futurelife	4.8% (n=1)
• Bullknox	4.8% (n=1)
When is it most important to eat carbohydrate rich foods?	
• Before training	66% (n=70)
• After training	32.1% (n=34)
• During training	1.9% (n=2)

From the above table the following trends were evident: (i) parents are the primary source of nutrition information and provide more than half (54.5%) the study participants with their general- and sports-related nutrition knowledge information(ii) more than half (57.8%) the study participants use nutritional supplements and the most prevalent use was reported as 3-4 times a week (27%) or daily (22.2%); (iii) protein shakes are the most popular supplement choice (38.2%) for those that indicated that they were using nutritional supplements; (iiii) 60% of the study participants would consider using a non-food supplement if it would help to achieve their sporting goals; (iv) nearly two thirds (68.6%) of the study participants have made changes to their diet to help achieve their goals with the three most popular changes being: making healthier food choices, increasing protein portions and consuming more fruit and vegetables; (vi) exercise/practice sessions, an optimal diet and rest were deemed critical to overall performance by the study participants, while gym/weight training was considered only very important (38%), and supplements were deemed not important at all (33.9%); (vii) more than half (56.5%) the study participants believe that timing

and consumption of carbohydrates will affect their performance but 32.4% indicated that they did not know whether it had an effect; (viii) less than 10% of the study participants were taking a supplement to help achieve their goals despite it possibly having negative side-effects; (ix) one fifth (19.3%) of the study participants were using a pre-workout supplement with the most popular choice being whey powder whilst and equal number were unsure of the brand; and (x) only 32.1% of the participants correctly identified that consuming carbohydrates after a workout is the most important time.

4.2.3 The general- and sports-related nutrition knowledge when comparing forwards to backline players

Table 4.5 presents the sample descriptives related to forwards (n=63) and backline (n=47) players including; age, residence, race, team and position in the team.

Table 4.5: Study sample descriptives of the forward (n=63) and backline (n=47) players (N=110)

Variable *	**Forwards % (n=63)**	**Backs % (n=47)**
Age (years):		
• Mean ± std. deviation	15.4 ± 1.5	15.0 ± 1.3
Race:		
• White	81.0% (n=51)	76.1% (n=35)
• African	18.5% (n=11)	21.7% (n=10)
• Indian	1.6% (n=1)	-
• Coloured	-	2.2% (n=1)
Accommodation:		
• Border	64.5% (n=40)	77.8% (n=35)
• Day scholar	35.5% (n=22)	22.2% (n=10)
Team:		
• First	11.1% (n=7)	8.5% (n=4)
• Second	4.8% (n=3)	-
• Third	9.5% (n=6)	6.4% (n=3)
• Fourth	4.8% (n=3)	4.3% (n=2)
• Under 16A	6.3% (n=4)	6.4% (n=3)
• Under 16B	9.5% (n=6)	4.3% (n=2)
• Under 16C	1.6% (n=1)	2.1% (n=1)
• Under 15A	9.5% (n=6)	8.5% (n=4)
• Under 15B	7.9% (n=5)	12.8% (n=6)
	14.3% (n=9)	8.5% (n=4)
• Under 15C	7.9% (n=5)	14.9% (n=7)
• Under 15D	6.3% (n=4)	12.8% (n=6)
• Under 14A	1.6% (n=1)	8.5% (n=4)
• Under 14B	4.8% (n=3)	2.1% (n=1)
• Under 14C		
Position in the team:		
Forwards:		
• Flank	38.1% (n=18)	
• Lock	26.6% (n=17)	
• Prop	21.9% (n=14)	
• Hooker	15.6% (n=10)	
• Eighth man	6.3% (n=4)	
• Loose forward	1.6% (n=1)	
Backs:		
• Wing		23.9% (n=11)
• Scrumhalf		17.4% (n=8)
• Inside centre		17.4% (n=8)
• Fullback		17.4% (n=8)
• Flyhalf		13% (n=6)
• Outside centre		10.9% (n=5)

*: No statistical significance seen between the sample descriptives of the forward and backline players

The above table depicts the mean age for the forward players (n=63) as being 15.41 and 14.96 for the backline players (n=47). Just over 80% of the forward and nearly 75% of the backline players are white. Consistent with the sample descriptives, more than half the forwards and backline players are borders at the school.

Table 4.6 shows the comparison of results generated by the true and false section of the general- and sports-related nutrition knowledge questionnaire between forwards and backline players.

Table 4.6: Comparison of knowledge generated from the true and false section of the general- and sports-related nutrition questionnaire between forwards (n=63) and backline (n=47) players (N=110)

Question *	**Forwards% (n=63)**		**Backs% (n=47)**	
		% (n)		**% (n)**
You should eat a lot of sugar to have enough energy:	• False • True	90.5% (n=57) 9.5% (n=6)	• False • True	83.0% (n=39) 17.0% (n=8)
You should add extra salt to your cooked food before you eat it:	• False • True	79.4% (n=50) 20.6% (n=13)	• False • True	80.9% (n=38) 19.1% (n=9)
If you are eating a healthy diet there is no need for you to be physically active:	• False • True	96.8% (n=61) 3.2% (n=2)	• False • True	95.7% (n=45) 4.3% (n=2)
All water is safe to drink	• False • True	90.5% (n=57) 9.5% (n=6)	• False • True	93.6% (n=44) 6.4% (n=3)
Your body only needs a little bit of salt to be healthy:	• True • False	77.8% (n=49) 22.2% (n=14)	• True • False	74.5% (n=35) 25.5% (n=12)
Sugar and foods that contain sugar should be eaten in small amounts:	• True • False	88.9% (n=56) 11.1% (n=7)	• True • False	85.1% (n=40) 14.9% (n=7)
Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods:	• True • False	66.7% (n=42) 33.3% (n=21)	• True • False	53.2% (n=25) 46.8% (n=22)
Sugar contains a lot of vitamins and minerals:	• False • True	82.5% (n=52) 17.5% (n=11)	• False • True	85.1% (n=40) 14.9% (n=7)
It is impossible to get all the vitamins and minerals you need from food, you need to take a vitamin and mineral pill:	• False • True	74.6% (n=47) 25.4% (n=16)	• False • True	76.6% (n=36) 23.4% (n=11)
Starchy foods should not be eaten when one is trying to lose weight:	• False • True	50.8% (n=32) 49.2% (n=31)	• True • False	57.4% (n=27) 40.4% (n=19)
Eating bread always causes weight gain:	• False • True	63.5% (n=40) 36.5% (n=23)	• False • True	60.9% (n=28) 41.3% (n=19)
It is healthy to snack on foods that contain a lot of sugar:	• False • True	85.7% (n=54) 14.3% (n=9)	• False • True	85.1% (n=40) 14.9% (n=7)
You can eat as much meat as you want every day:	• False • True	63.5% (n=40) 36.5% (n=23)	• False • True	70.2% (n=33) 29.8% (n=14)
Dry beans, peas, lentils are a healthy choice to eat in place of meat:	• True • False	55.6% (n=35) 44.4% (n=28)	• True • False	61.7% (n=29) 38.3% (n=18)
I supplement my diet with food items/ alternatives:	• False • True	54.0% (n=34) 46.0% (n=29)	• False • True	53.2% (n=25) 44.7% (n=21)
It is necessary to supplement your diet (use supplements) to build mass:	• False • True	73.0% (n=46) 27.0% (n=17)	• False • True	70.2% (n=33) 29.8% (n=14)
Fats are necessary in your diet as they provide additional energy and vitamins:	• True • False	90.5% (n=57) 9.5% (n=6)	• True • False	85.1% (n=40) 14.9% (n=7)

There is a difference between good and bad fats in food:	• True • False	90.5% (n=57) 9.5% (n=6)	• True • False	89.4% (n=42) 10.6% (n=5)
Pre- workout meals/ drinks should contain carbohydrates:	• True • False	75.8% (n=47) 24.1% (n=15)	• True • False	80.4% (n=37) 19.6% (n=9)
Caffeinated energy drinks are necessary for an energy boost before practice or a game:	• False • True	81.0% (n=51) 19.0% (n=12)	• False • True	86.9% (n=40) 13% (n=6)
There is a difference between a sport drink and an energy drink:	• True • False	79.4% (n=50) 20.6% (n=13)	• True • False	70.2% (n=33) 29.8% (n=14)
My diet changes between pre, during and post season:	• True • False	51.6% (n=32) 48.3% (n=30)	• False • True	55.3% (n=26) 44.7% (n=21)
What I eat affects my performance, recovery and body composition more than additional supplements:	• True • False	83.9% (n=52) 16.1% (n=10)	• True • False	72.3% (n=34) 27.7% (n=13)
Post workout meals/ drinks should contain carbohydrates:	• True • False	63.9% (n=39) 36.1% (n=22)	• True • False	66.0% (n=31) 34.0% (n=16)

*No statistically significant differences found between forwards and backline players.

From the results in table 4.6 it is clear that both the forwards and backline players have an adequate nutritional knowledge in that forwards answered all the questions correctly, while the backline players answered 95% of the questions correctly (there were two questions regarding personal supplement usage habits that were not included in obtaining this result as these are not related to the general- and sports-related nutrition knowledge of the participants). The results further show that there are slight differences in the beliefs and approach to nutrition between the forwards and backline players. Nearly 60% of the backline players believe that starchy foods should not be eaten when trying to lose weight as opposed to nearly 60% of the forwards that believe that eating starchy foods does not cause weight gain. Indicating a pre-held misconception concern regarding the knowledge and beliefs regarding carbohydrate consumption and a common trend seen amongst forward and backline players. Just over half (51.6%) the forwards and backline (55.3%) players indicated that their diets change between sporting seasons. Less than half the forward (46%) and backline (44.7%) players supplement their diets in addition to food.

Table 4.7 indicates the comparison of results generated by the multiple choice section of the general- and sports-related nutrition knowledge questionnaire between the forwards and backline players

Table 4.7: Comparison of knowledge generated from the multiple choice section of the general- and sports-related nutrition questionnaire between forwards (n=63) and backline (n=47) players (N=110)

Question	**Forwards% (n=63)**	**Backs% (n=47)**	**P-value** #
You should not have starches at most meals because:			
• None of the above	50% (n=31)	58.7% (n=27)	0.815
• Cause weight gain	32.3% (n=20)	28.3% (n=13)	
• Not important for health	12.9% (n=8)	8.7% (n=4)	
• Cause disease	4.8% (n=3)	4.3% (n=2)	
How much water should you drink a day?			
• 7-9 glasses	49.2% (n=31)	51.1% (n=24)	0.650
• 4-6 glasses	42.9% (n=27)	42.6% (n=20)	
• 1-3 glasses	4.8% (n=3)	6.4% (n=3)	
• Don't have to drink water everyday	3.2% (n=2)	-	
Which of the following is a low fat snack:			
• Popcorn	76.2% (n=48)	68.1% (n=32)	0.200
• Niknaks	17.5% (n=11)	12.8% (n=6)	
• Simba chips	3.2% (n=2)	12.8% (n=6)	
• Fried chips	3.2% (n=2)	6.4% (n=3)	
From which food group should you eat the most every day?			
• Chicken, fish, beans, eggs	47.6% (n=30)	43.5% (n=20)	0.680
• Apple, banana, spinach, carrots	44.4% (n=28)	41.3% (n=19)	
• Bread, samp, rice, porridge	6.3% (n=4)	10% (n=6)	
• Milk, yogurt, cheese	1.6% (n=1)	2.2% (n=1)	
Key to healthy eating is to:			
• All of the above	58.7% (n=37)	42.6% (n=20)	0.062
• Certain foods in small/ moderate amounts	19.0% (n=12)	42.6% (n=20)	
• Many different kinds of foods	11.1% (n=7)	8.5% (n=4)	
• Some foods more than others	11.1% (n=7)	6.4% (n=3)	
Which foods contain a lot of calcium?			
• Milk, yogurt	64.5% (n=40)	63.8% (n=30)	0.849
• Chicken and eggs	30.6% (n=19)	29.8% (n=14)	
• Pilchards	3.2% (n=2)	2.1% (n=1)	
• Milk, yogurt and pilchards	1.6% (n=1)	4.3% (n=2)	
Being physically active means:			
• all of the above	92.1% (n=58)	97.9% (n=46)	0.387
• playing sports	6.3% (n=4)	2.1% (n=1)	
• going to gym	1.6% (n=1)	-	
How many fruits and vegetables should be eaten on a daily basis			
• 3-4/ day	69.3% (n=43)	53.2% (n=25)	0.378
• More than 5/ day	19.4% (n=12)	31.9% (n=15)	
• 1/ day	9.7% (n=6)	12.8% (n=6)	
• No need to eat fruit and veg daily	1.6% (n=1)	2.1% (n=1)	

How much milk or maas should be consumed per day?			
• 1 cup	49.2% (n=31)	43.5% (n=20)	0.618
• 2 cups	36.5% (n=23)	47.8% (n=22)	
• Half a cup	9.5% (n=6)	6.5% (n=3)	
• None	4.8% (n=3)	2.2% (n=1)	
A well balanced diet consists of:			
• Mostly meat	41.9% (n=26)	34.8% (n=16)	0.548
• Mostly veg	35.5% (n=22)	30.4% (n=14)	
• None of the above	12.9% (n=8)	17.4% (n=8)	
• Mostly starch, veg and fruit	9.7% (n=6)	17.4% (n=8)	
Which of the following breakfast menus are low in fat?			
• Weet-bix with 2% milk and whole-wheat toast with little margarine	53.2% (n=33)	53.2% (n=25)	0.826
• Weet-bix with 2% milk	25.8% (n=16)	31.9% (n=15)	
• Bacon and egg	14.5% (n=9)	10.6% (n=5)	
• Whole-wheat toast with little margarine	6.5% (n=4)	4.3% (n=2)	
Which food contains the most fibre?			
• Whole-wheat bread	69.8% (n=44)	52.3% (n=23)	0.265
• Brown bread	17.5% (n=11)	22.7% (n=10)	
• What is fibre?	7.9% (n=5)	13.6% (n=6)	
• White bread	4.8% (n=3)	11.4% (n=5)	
The reason why beans, peas and lentils are good for you is that:			
• All of the above	65.1% (n=41)	47.8% (n=22)	0.011#
• Contain little fat	15.9% (n=10)	28.3% (n=13)	
• Contain high fibre	9.5% (n=6)	23.9% (n=11)	
• Can protect from disease	9.5% (n=6)	-	
It is important to stay hydrated:			
• Before, during and after exercise	90.5% (n=57)	68.1% (n=32)	0.012#
• During and after exercise	4.8% (n=3)	19.1% (n=9)	
• After exercise	3.2% (n=2)	12.8% (n=6)	
• During exercise	1.6% (n=1)	-	
The following energy drinks contain caffeine:			
• All of the above	91.8% (n=56)	91.5% (n=43)	0.164
• Red bull	4.9% (n=3)	8.5% (n=4)	
• Monster	3.3% (n=2)	-	
Correct beverage to drink during a workout is:			
• Powerade	93.5% (n=58)	85.1% (n=40)	0.095
• Coca Cola	4.8% (n=3)	6.4% (n=3)	
• All of the above	-	8.5% (n=4)	
• Monster	1.6% (n=1)	-	

#: Chi-square test shows statistical significance

From Table 4.7 it is evident that there was no significant difference in the nutritional knowledge between forwards and backline players. The only significant difference was noted regarding the questions stating the reason why beans, peas and lentils are healthy and the reason why it is important to stay hydrated. The results show an

adequate general- and sports-related nutrition knowledge, as 62.5% of the questions were answered correctly by both the forwards and backline players. The remaining 37.5% of the questions that were answered incorrectly indicate that both the forwards and backline players lack knowledge regarding carbohydrate consumption, the food groups that should be eaten the most of on a daily basis, what constitutes a well-balanced diets and what healthy eating entails. . Furthermore, ‘mostly meat’ and ‘mostly veg’ are considered to be the basis of a well- balanced meal by both the forwards and the backs. 58.7% and 42.6% of the forwards and backline players, respectively, chose “all of the above” as their preferred answer to the question pertaining to what healthy eating entails. In addition, only 3.2% and 2.1% of the forwards and backline players, respectively, knew that pilchards are a good source of calcium.

Table 4.8 compares of the results generated by the final section of the general- and sports-related nutrition knowledge questionnaire between the forwards and backline players. This section includes aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing.

Table 4.8: Comparison of results generated from the final section of the general- and sports-related nutrition knowledge questionnaire between forwards (n=63) and backline (n=47) players (N=110)

Question	**Forwards% (n=63)**	**Backs% (n=47)**	**P-value** #
Source of nutrition information (more than one option could be chosen):			
• Parents	52.4% (n=33)	57.4% (n=27)	α
• Media	47.6% (n=30)	44.7% (n=21)	α
• School	34.9% (n=22)	46.8% (n=22)	α
• Peers/ friends	28.6% (n=18)	36.2% (n=17)	α
• Other	20.6% (n=13)	4.3% (n=2)	α
Do you use nutritional supplements?			
• Yes	58.7% (n=37)	56.5% (n=26)	0.818
• No	41.3% (n=26)	43.5% (n=20)	
Frequency of supplement use:			
• 3-4 times a week	21.6% (n=8)	34.6% (n=9)	0.356
• Daily	27% (n=10)	15.3% (n=4)	
• Once or twice a week	24.3% (n=9)	15.3% (n=4)	
• Less than weekly	13.5% (n=5)	26.9% (n=7)	
• Once a week	13.5% (n=5)	4.3% (n=2)	
Most frequently used supplement (more than one option could be chosen):			
• Protein shake	39.7% (n=25)	36.2% (n=17)	α
• Energy drinks	23.8% (n=15)	12.8% (n=6)	α
• Meal replacements	14.3% (n=9)	6.4% (n=3)	α
• Mass builder	9.5% (n=6)	8.5% (n=4)	α
• Creatine	7.9% (n=5)	8.5% (n=4)	α
• Fat burner	9.5% (n=6)	2.1% (n=1)	α
• Amino acids	9.5% (n=6)	-	α
• Other	4.8% (n=3)	6.4% (n=3)	α
• Taking one but unsure what it is	3.2% (n=2)	4.3% (n=2)	α
Have you ever considered taking a non-food supplement to improve sporting performance or help achieve goals?			
• Yes	70% (n=42)	54.5% (n=24)	0.106
• No	30% (n=18)	45.5% (n=20)	
Have you considered changing your diet to help achieve your goals?			
• Yes	66.7% (n=40)	71.1% (n=32)	0.627
• No	33.3% (n=20)	28.9% (n=13)	
Dietary changes made (more than one option could be chosen):			
• Healthier food choices, no junk food	57.1% (n=36)	46.8% (n=22)	α
• Increased protein portions	49.2% (n=31)	46.8% (n=22)	α
• More veg and fruit	47.6% (n=30)	31.9% (n=15)	α
• Cut out snacking between meals	28.6% (n=18)	12.8% (n=6)	α

• Decreased carb portions	27.0% (n=17)	17.0% (n=8)	α
• Planned snacks around exercise	23.8% (n=15)	8.5% (n=4)	α
• Increased carb portions	19.0% (n=12)	21.3% (n=10)	α
• Included snacks between meals	1.6% (n=1)	6.4% (n=3)	α
• Other	1.6% (n=1)	2.1% (n=1)	α
• Decreased protein portions	1.6% (n=1)	2.1% (n=1)	α
Rate the importance of exercise or practice sessions to your overall performance:			
• Critical, can't achieve without it	66.7% (n=42)	69.6% (n=32)	0.892
• Very important	25.4% (n=16)	26.1% (n=12)	
• Fairly important	4.8% (n=3)	2.2% (n=1)	
• Helps a little	3.2% (n=2)	2.2% (n=1)	
	-	-	
Rate the importance of gym or weight training to your overall performance:			
• Very important	45.2% (n=28)	28.3% (n=13)	0.322
• Fairly important	27.4% (n=17)	39.1% (n=18)	
• Critical, can't achieve without it	14.5% (n=9)	10.9% (n=5)	
• Helps a little	9.7% (n=6)	17.4% (n=8)	
• Not important	3.2% (n=2)	4.3% (n=2)	
Rate the importance of diet/ what you eat to your overall performance:			
• Critical, can't achieve without it	41.9% (n=26)	53.2% (n=25)	0.689
• Very important	37.1% (n=23)	34.0% (n=16)	
• Fairly important	12.9% (n=8)	8.5% (n=4)	
• Helps a little	6.5% (n=4)	4.3% (n=2)	
• Not important	1.6% (n=1)	-	
Rate the importance of rest to your overall performance:			
• Critical, can't achieve without it	47.6% (n=30)	59.6% (n=28)	0.294
• Very important	28.6% (n=18)	23.4% (n=11)	
• Fairly important	12.7% (n=8)	14.9% (n=7)	
• Helps a little	7.9% (n=5)	-	
• Not important	3.2% (n=2)	2.1% (n=1)	
Rate the importance of supplements to your overall performance:			
• Not important	33.9% (n=21)	34.0% (n=16)	0.791
• Helps a little	27.4% (n=17)	34.0% (n=16)	
• Fairly important	21% (n=13)	14.9% (n=7)	
• Very important	16.1% (n=10)	17.0% (n=8)	
• Critical, can't achieve without it	1.6% (n=1)	-	
Can carbohydrate-rich foods eaten before, during or after training affect performance?			
• Yes	61.3% (n=38)	50% (n=23)	0.179
• I don't know	32.3% (n=20)	32.6% (n=15)	
• No	6.5% (n=4)	17.4% (n=8)	
Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure?			
• No	85.2% (n=52)	97.8% (n=45)	0.027#

• Yes	14.8% (n=9)	2.2% (n=1)	
Are you using a pre-workout supplement?			
• No	75.8% (n=47)	87.2% (n=41)	0.134
• Yes	24.2% (n=15)	12.8% (n=6)	
Pre-workout supplement brand:			
• I don't know	13.3% (n=2)	16.7% (n=1)	0.526
• Whey powder	6.7% (n=1)	33.3% (n=2)	
• No-name brand	13.3% (n=2)	-	
• Evox	6.7% (n=1)	16.7% (n=1)	
• Beast mode	13.3% (n=2)	-	
• ECA-stack	6.7% (n=1)	-	
• Ensure	6.7% (n=1)	-	
• ECA	6.7% (n=1)	-	
• Gaterade	-	16.7% (n=1)	
• Boot extreme	6.7% (n=1)	-	
• USN explode	6.7% (n=1)	-	
• USN	6.7% (n=1)	-	
• Futurelife	-	16.7% (n=1)	
• Bullknox	6.7% (n=1)	-	
When is it most important to eat carbohydrate rich foods?			
• Before training	68.9% (n=42)	62.2% (n=28)	0.232
• After training	31.1% (n=19)	33.3% (n=15)	
• During training	-	4.4% (n=2)	

#: Chi-square test
α: No statistics were computed as this value is a constant

There was a statistically significant difference between the forwards and backline players in terms of whether they are taking a supplement to enhance performance that may have negative side-effects but they are unsure whether this is the case.

In addition, Table 4.8 further illustrates the following trends: (i) more than 50% of both the forward and backline players obtained their nutrition information from their parents, followed by the media; (ii) 58.7% of the forwards and 56.5% of the backline players use a nutritional supplement of which the majority of forwards use them daily (27%) while the majority of backline players use them three to four times a week (34.6%); (iii) the most commonly used supplement by both the forwards (39.7%) and backline players (36.2%) was a protein shake; (iv) 70% of the forwards and 54.5% of the backline players said that they would consider taking a non-food supplement that may help them to achieve their sporting goals; (v) both the forwards (66.7%) and backline players (71.1%) have made changes to their diet to help them achieve their goals with the three most popular changes for both the forwards and backline players being:

making healthier food choices, increasing protein portions and increasing the consumption of vegetables and fruit; (vi) diet, rest and exercise/practice sessions were deemed critical to overall performance by both forwards and backline players, while gym/weight training was indicated as ‘very important’ to the forwards and ‘fairly’ important to the backline players.

The majority of forwards (33.9%) and backline players (34.0%) considered supplements to be unimportant in their overall achievement but 27.4% and 34.0% for the forwards and backline players, respectively, believed it helps a little; (vii) 61.3% of the forwards and 50% of the backline players believed that carbohydrate rich foods can affect performance but nearly a third of both the forwards (32.3%) and backline players (32.6%) indicated that they did not know; (ix) a statistically significant result showed that just over eight out of ten (85.2%) of forward and nearly all (97.8%) of backline players indicated that they were not taking a supplement that they were unsure of or that may have a negative side-effect while 75.8% of the forwards and 87.2% of the backline players were not taking any pre-workout supplements; and (x) both forwards and backline players seemingly lacked knowledge regarding carbohydrates, the timing of carbohydrate intake and how it works in the body as only 31.1% of forwards and 33.3% of backs, respectively, selected the correct answer.

4.2.4 The general- and sports-related nutrition knowledge from the under 14 age group to the open age group.

Table 4.9 indicates the study sample descriptives specific to the age groups: under 14 (n=19); under 15 (n=46); under 16 (n=17) and open age category (n=28)

Table 4.9: Study sample descriptives specific to the age groups: under 14 (n=19); under 15 (n=46); under 16 (n=17) and open age category (n=28) (N=110)

Variable	U14 % (n=19)	U15 % (n=46)	U16 % (n=17)	Open % (n=28)
Age (years): Mean ± std. deviation	13.7 ± 0.5	14.5 ± 0.5	15.4 ± 0.6	17.3 ± 0.8
Race:				
• White	77.7% (n=14)	78.3% (n=36)	70.6% (n=12)	85.7% (n=24)
• African	22.2% (n=4)	17.4% (n=8)	29.4% (n=5)	14.3% (n=4)
• Indian	-	2.2% (n=1)	-	-
• Coloured	-	2.2% (n=1)	-	-
Accommodation:				
• Boarder	82.4% (n=14)	67.4% (n=31)	70.6% (n=12)	66.6% (n=18)
• Day scholar	17.6% (n=3)	32.6% (n=15)	29.4% (n=5)	33.3% (n=9)
Team:				
• First				39.3% (n=11)
• Second				10.7% (n=3)
• Third				32.1% (n=9)
• Fourth				17.9% (n=5)
• Under 16A			41.2% (n=7)	
• Under 16B			47.1% (n=8)	
• Under 16C			11.8% (n=2)	
• Under 15A		21.7% (n=10)		
• Under 15B		23.9% (n=11)		
• Under 15C		28.3% (n=13)		
• Under 15D		26.1% (n=12)		
• Under 14A	52.6% (n=10)			
• Under 14B	26.3% (n=5)			
• Under 14C	21.1% (n=4)			
Position in the team:				
Forwards				
• Flank	15.8% (n=3)	19.6% (n=9)	16.7% (n=2)	14.3% (n=4)
• Lock	15.8% (n=3)	10.9% (n=5)	41.7% (n=5)	14.3% (n=4)
• Prop	5.3% (n=1)	10.9% (n=5)	16.7% (n=2)	21.4% (n=6)
• Hooker	-	10.9% (n=5)	16.7% (n=2)	10.7% (n=3)
• Loose forward	-	-	-	3.6% (n=1)
Backs				
• Wing		13.0% (n=6)	8.3% (n=1)	3.6% (n=1)
• Scrumhalf	15.8% (n=3)	6.5% (n=3)	-	7.1% (n=2)
• Inside centre	15.8% (n=3)	4.3% (n=2)	-	7.1% (n=2)
• Fullback	10.5% (n=2)	10.9% (n=5)	-	3.6% (n=1)
• Flyhalf	-	6.5% (n=3)	-	3.6% (n=1)
• Outside centre	10.5% (n=2)	2.2% (n=1)	-	7.1% (n=2)
• Eighth man	5.3% (n=1)	4.3% (n=2)	-	3.6% (n=1)
	5.3% (n=1)			

Table 4.9 depicts an average age of 13.7 for the under 14 age group, 14.5 for the under 15 age group, 15.4 for the under 16 age group and 17.3 for the open age group.

Across the various age categories, between 70-80% of the players were white while between 60-70% of the players were boarders at the school.

Table 4.10 represents the comparison of results in the true and false section of the general- and sports-related nutrition knowledge questionnaire between each age group.

Table 4.10: Comparison of knowledge generated from the true and false section of the general- and sports-related nutrition questionnaire between the age groups: under 14 (n=19); under 15 (n=46); under 16 (n=17) and open (n=28) (N=110)

Question	U14		U15		U16		Open	
		% (n=19)		% (n=46)		% (n=17)		% (n=28)
You should eat a lot of sugar to have enough energy: (P= 0.034) #	• False • True	89.5% (n=17) 10.5% (n=2)	• False • True	84.8% (n=39) 15.2% (n=7)	• False • True	70.6% (n=12) 29.4% (n=5)	• False • True	100% (n=28) -
You should add extra salt to your cooked food before you eat it: (p= 0.007) #	• False • True	73.7% (n=14) 26.3% (n=5)	• False • True	91.3% (n=42) 8.7% (n=4)	• False • True	52.9% (n=9) 47.1% (n=8)	• False • True	82.1% (n=23) 17.9% (n=5)
If you are eating a healthy diet there is no need for you to be physically active:	• False • True	94.7% (n=18) 5.3% (n=1)	• False • True	95.7% (n=44) 4.3% (n=2)	• False • True	100% (n=17) -	• False • True	96.4% (n=27) 3.6% (n=1)
All water is safe to drink	• False • True	89.5% (n=17) 10.5% (n=2)	• False • True	93.5% (n=43) 6.5% (n=3)	• False • True	82.4% (n=14) 17.6% (n=3)	• False • True	96.4% (n=27) 3.6% (n=1)
Your body only needs a little bit of salt to be healthy:	• True • False	78.9% (n=15) 21.1% (n=4)	• True • False	78.3% (n=36) 21.7% (n=10)	• True • False	70.6% (n=12) 29.4% (n=5)	• True • False	75.0% (n=21) 25.0% (n=7)
Sugar and foods that contain sugar should be eaten in small amounts:	• True • False	89.5% (n=17) 10.5% (n=2)	• True • False	82.6% (n=38) 17.4% (n=8)	• True • False	82.4% (n=14) 17.6% (n=3)	• True • False	96.4% (n=27) 3.6% (n=1)
Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods:	• True • False	52.6% (n=10) 47.4% (n=9)	• True • False	67.4% (n=31) 32.6% (n=15)	• True • False	52.9% (n=9) 47.1% (n=8)	• True • False	60.7% (n=17) 39.3% (n=11)
Sugar contains a lot of vitamins and minerals: (p= 0.045) #	• False • True	84.2% (n=16) 15.8% (n=3)	• False • True	76.1% (n=35) 23.9% (n=11)	• False • True	76.5% (n=13) 23.5% (n=4)	• False • True	100% (n=28) -
It is impossible to get all the vitamins and minerals you need from food, you need to take a vitamin and mineral pill:	• False • True	68.4% (n=13) 31.6% (n=6)	• False • True	80.4% (n=37) 19.6% (n=9)	• False • True	76.5% (n=13) 23.5% (n=4)	• False • True	71.4% (n=20) 28.6% (n=8)
Starchy foods should not be eaten when one is trying to lose weight:	• True • False	61.1% (n=11) 38.9% (n=7)	• False • True	52.2% (n=24) 47.8% (n=22)	• True • False	52.9% (n=9) 47.1% (n=8)	• True • False	57.1% (n=16) 42.9% (n=12)
Eating bread always causes weight gain:	• False • True	68.4% (n=13) 31.6% (n=6)	• False • True	63.0% (n=29) 37.0% (n=17)	• False • True	70.6% (n=12) 29.4% (n=5)	• False • True	50.0% (n=14) 50.0% (n=14)

It is healthy to snack on foods that contain a lot of sugar:	• False • True	84.2% (n=16) 15.8% (n=3)	• False • True	84.8% (n=39) 15.2% (n=7)	• False • True	70.6% (n=12) 29.4% (n=5)	• False • True	96.4% (n=27) 3.6% (n=1)
You can eat as much meat as you want every day:	• False • True	63.2% (n=12) 36.8% (n=7)	• False • True	73.9% (n=34) 26.1% (n=12)	• False • True	58.8% (n=10) 41.2% (n=7)	• False • True	60.7% (n=17) 39.3% (n=11)
Dry beans, peas, lentils are a healthy choice to eat in place of meat:	• False • True	52.6% (n=10) 47.4% (n=9)	• True • False	63.0% (n=29) 37.0% (n=17)	• True • False	52.9% (n=9) 47.1% (n=8)	• True • False	60.7% (n=17) 39.3% (n=11)
I supplement my diet with food items/ alternatives:	• True • False	52.6% (n=10) 47.4% (n=9)	• False • True	54.3% (n=25) 45.7% (n=21)	• False • True	52.9% (n=9) 47.1% (n=8)	• False • True	59.3% (n=16) 40.7% (n=11)
It is necessary to supplement your diet (use supplements) to build mass:	• False • True	78.9% (n=15) 21.1% (n=4)	• False • True	78.3% (n=36) 21.7% (n=10)	• False • True	52.9% (n=9) 47.1% (n=8)	• False • True	67.9% (n=19) 32.1% (n=9)
Fats are necessary in your diet as they provide additional energy and vitamins:	• True • False	94.7% (n=18) 5.3% (n=1)	• True • False	84.8% (n=39) 15.2% (n=7)	• True • False	88.2% (n=15) 11.8% (n=2)	• True • False	89.3% (n=25) 10.7% (n=3)
There is a difference between good and bad fats in food:	• True • False	84.2% (n=16) 15.8% (n=3)	• True • False	87.0% (n=40) 13.0% (n=6)	• True • False	88.2% (n=15) 11.8% (n=2)	• True • False	100% (n=28) -
Pre- workout meals/ drinks should contain carbohydrates:	• True • False	83.3% (n=15) 16.7% (n=3)	• True • False	73.9% (n=34) 26.1% (n=12)	• True • False	75% (n=12) 25% (n=4)	• True • False	82.1% (n=23) 17.9% (n=5)
Caffeinated energy drinks are necessary for an energy boost before practice or a game:	• False • True	68.4% (n=13) 31.6% (n=6)	• False • True	91.1% (n=41) 8.9% (n=4)	• False • True	88.2% (n=15) 11.8% (n=2)	• False • True	78.6% (n=22) 21.4% (n=6)
There is a difference between a sport drink and an energy drink:	• True • False	68.4% (n=13) 31.6% (n=6)	• True • False	69.6% (n=32) 30.4% (n=14)	• True • False	82.4% (n=14) 17.6% (n=3)	• True • False	85.7% (n=24) 14.3% (n=4)
My diet changes between pre, during and post season:	• False • True	52.6% (n=10) 47.4% (n=9)	• False • True	58.7% (n=27) 41.3% (n=19)	• False • True	62.5% (n=10) 37.5% (n=6)	• True • False	67.9% (n=19) 32.1% (n=9)
What I eat affects my performance, recovery and body composition more than additional supplements:	• True • False	68.4% (n=13) 31.6% (n=6)	• True • False	82.6% (n=38) 17.4% (n=8)	• True • False	68.8% (n=11) 31.3% (n=5)	• True • False	85.7% (n=24) 14.3% (n=4)
Post workout meals/ drinks should contain carbohydrates:	• True • False	78.9% (n=15) 21.1% (n=4)	• True • False	65.2% (n=30) 34.8% (n=16)	• True • False	60% (n=9) 40% (n=6)	• True • False	57.1% (n=16) 42.9% (n=12)

#: Chi-square test shows statistically significant differences in the nutrition knowledge from the under 14 age group to the open age group in these three questions

Statistically significant differences across age categories/groups reported in table 4.10 above include: “You should eat a lot of sugar to have enough energy”, “You should add extra salt to your cooked food before you eat it” and “Sugar contains a lot of vitamins and minerals”. However, it is evident that the under 14, 15, 16 and open age groups share a similar opinion and have a similar general- and sports-related nutrition knowledge for the remainder of the questions. The under 14, under 16 and open age groups all scored 95% and the under 15 age group scored 100% (two questions regarding personal supplement usage were not included in obtaining this result) indicating that they all have an adequate general- and sports-related nutrition knowledge.

The area of concern for the age groups that scored less than 100% is carbohydrates. The under 14, under 16 and open groups all believed that starchy foods should not be eaten when trying to lose weight. The open age group were also evenly divided in their opinion as to whether ‘eating bread always causes weight gain’. The under 14 age group was the only group that indicated that their diets are supplemented with nutritional supplements while the open age group was the only group who indicated that their diet changes between seasons.

Table 4.11 indicates the comparison of results from the multiple choice section of the general- and sports-related nutrition knowledge questionnaire between each age group. This section includes aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing.

Table 4.11: Comparison of knowledge generated from the multiple choice section of the general- and sports-related nutrition questionnaire between the age groups: under 14 (n=19); under 15 (n=46); under 16 (n=17) and open (n=28) (N=110)

Question	U14% (n=19)	U15% (n=46)	U16% (n=17)	Open% (n=28)
You should not have starches at most meals because:				
• None of the above	52.9% (n=9)	56.5% (n=26)	64.7% (n=11)	42.9% (n=12)
• Cause weight gain	35.3% (n=6)	21.7% (n=10)	17.6% (n=3)	50.0% (n=14)
• Not important for health	11.8% (n=2)	17.4% (n=8)	11.8% (n=2)	7.1% (n=2)
• Cause disease	-	4.3% (n=2)	5.9% (n=1)	-
How much water should you drink a day?				
• 7-9 glasses	36.8% (n=7)	56.5% (n=26)	47.1% (n=8)	50.0% (n=14)
• 4-6 glasses	47.4% (n=9)	37.0% (n=17)	41.2% (n=7)	50.0% (n=14)
• 1-3 glasses	5.3% (n=1)	6.5% (n=3)	11.8% (n=2)	-
• Don't have to drink water everyday	10.5% (n=2)	-	-	-
Which of the following is a low fat snack:				
• Popcorn	57.9% (n=11)	67.4% (n=31)	70.6% (n=12)	92.9% (n=26)
• Niknaks	21.1% (n=4)	15.2% (n=7)	23.5% (n=4)	7.1% (n=2)
• Simba chips	10.5% (n=2)	10.9% (n=5)	5.9% (n=1)	-
• Fried chips	10.5% (n=2)	6.5% (n=3)	-	-
From which food group should you eat the most every day?				
• Chicken, fish, beans, eggs	31.6% (n=6)	47.8% (n=22)	56.3% (n=9)	46.4% (n=13)
• Apple, banana, spinach, carrots	47.4% (n=9)	45.7% (n=21)	37.5% (n=6)	39.3% (n=11)
• Bread, samp, rice, porridge	15.8% (n=3)	6.5% (n=3)	6.3% (n=1)	10.3% (n=3)
• Milk, yogurt, cheese	5.3% (n=1)	-	-	3.6% (n=1)
Key to healthy eating is to:				
• All of the above	31.6% (n=6)	54.3% (n=25)	52.9% (n=9)	60.7% (n=17)
• Certain foods in small/ moderate amounts	31.6% (n=6)	23.9% (n=11)	29.4% (n=5)	35.7% (n=10)
• Many different kinds of foods	10.5% (n=2)	15.2% (n=7)	5.9% (n=1)	3.6% (n=1)
• Some foods more than others	26.3% (n=5)	6.5% (n=3)	11.8% (n=2)	-
Which foods contain a lot of calcium?				
• Milk, yogurt	52.6% (n=10)	62.2% (n=28)	64.7% (n=11)	75.0% (n=21)
• Chicken and eggs	36.8% (n=7)	33.3% (n=15)	29.4% (n=5)	21.4% (n=6)
• Pilchards	-	2.2% (n=1)	5.9% (n=1)	3.6% (n=1)

• Milk, yogurt and pilchards	10.5% (n=2)	2.2% (n=1)	-	-
Being physically active means: (p= 0.002) #				
• all of the above	73.7% (n=14)	100% (n=46)	94.1% (n=16)	100% (n=28)
• playing sports	21.1% (n=4)	-	5.9% (n=1)	-
• going to gym	5.3% (n=1)	-	-	-
How many fruits and vegetables should be eaten on a daily basis				
• 3-4/ day	57.9% (n=11)	54.3% (n=25)	68.8% (n=11)	75.0% (n=21)
• More than 5/ day	26.3% (n=5)	34.8% (n=16)	12.5% (n=2)	14.3% (n=4)
• 1/ day	10.5% (n=2)	10.9% (n=5)	18.8% (n=3)	7.1% (n=2)
• No need to eat fruit and veg daily	5.3% (n=1)	-	-	3.6% (n=1)
How much milk or maas should be consumed per day? (p= 0.021) #				
• 1 cup	42.1% (n=8)	40% (n=18)	35.3% (n=6)	67.9% (n=19)
• 2 cups	31.6% (n=6)	44.4% (n=20)	58.8% (n=10)	32.1% (n=9)
• Half a cup	10.5% (n=2)	13.3% (n=6)	5.9% (n=1)	-
• None	15.8% (n=3)	2.2% (n=1)	-	-
A well balanced diet consists of:				
• Mostly meat	31.6% (n=6)	40% (n=18)	52.9% (n=9)	33.3% (n=9)
• Mostly veg	47.4% (n=9)	35.6% (n=16)	11.0% (n=2)	33.3% (n=9)
• None of the above	10.5% (n=2)	15.6% (n=7)	17.6% (n=3)	14.8% (n=4)
• Mostly starch, veg and fruit	10.5% (n=2)	8.9% (n=4)	17.6% (n=3)	18.5% (n=5)
Which of the following breakfast menus are low in fat?				
• Weet-bix with 2% milk and whole-wheat toast with little margarine	36.8% (n=7)	54.3% (n=25)	50% (n=8)	64.3% (n=18)
• Weet-bix with 2% milk	42.1% (n=8)	26.1% (n=12)	37.5% (n=6)	17.9% (n=5)
• Bacon and egg	15.8% (n=3)	15.2% (n=7)	6.3% (n=1)	10.3% (n=3)
• Whole-wheat toast with little margarine	5.3% (n=1)	4.3% (n=2)	6.3% (n=1)	7.1% (n=2)
Which food contains the most fibre?				
• Whole-wheat bread	36.8% (n=7)	62.2% (n=28)	81.3% (n=13)	70.4% (n=19)
• Brown bread	31.6% (n=6)	20% (n=9)	12.5% (n=2)	14.8% (n=4)
• What is fibre?	21.1% (n=4)	13.3% (n=6)	-	3.7% (n=1)
• White bread	10.5% (n=2)	4.4% (n=2)	6.3% (n=1)	11.1% (n=3)
The reason why beans, peas and lentils are good for you is that:				
• All of the above	36.8% (n=7)	57.8% (n=26)	64.7% (n=11)	67.9% (n=19)

• Contain little fat • Contain high fibre • Can protect from disease	26.3% (n=5) 36.8% (n=7) -	17.8% (n=8) 15.6% (n=7) 8.9% (n=4)	29.4% (n=5) 5.9% (n=1) -	17.9% (n=5) 7.1% (n=2) 7.1% (n=2)
It is important to stay hydrated: • Before, during and after exercise • During and after exercise • After exercise • During exercise	 84.2% (n=16) 10.5% (n=2) 5.3% (n=1) -	 80.4% (n=37) 15.2% (n=7) 2.2% (n=1) 2.2% (n=1)	 88.2% (n=15) - 11.8% (n=2) -	 75.0% (n=21) 10.7% (n=3) 14.3% (n=4) -
The following energy drinks contain caffeine: • All of the above • Red bull • Monster	 94.4% (n=17) 5.6% (n=1) -	 93.5% (n=43) 2.2% (n=1) 4.3% (n=2)	 100% (n=17) - -	 81.5% (n=22) 3.7% (n=1) 14.8% (n=4)
Correct beverage to drink during a workout is: • Powerade • Coca Cola • All of the above • Monster	 89.5% (n=17) 5.3% (n=1) - 5.3% (n=1)	 90.9% (n=40) 9.1% (n=4) - -	 94.1% (n=16) - 5.9% (n=1) -	 96.2% (n=25) 3.8% (n=1) - -

#: Chi-square test shows statistically significant result

As per the results reported in Table 4.11, there were two statistically significant differences in nutrition knowledge across the various age groups: “being physically active means…” and “how much milk or maas should be consumed per day”. In addition, Table 4.10 also shows that there were no significant differences in the general- and sports-related nutrition knowledge across age groups for aspects like starches and carbohydrates. All four age groups had an adequate general- and sports-related nutrition knowledge as 67.8% of the questions were answered correctly by the under 14, under 15 and under 16 age groups, while 62.5% of the questions were answered correctly by the open age group.

The remaining 32.3% and 37.5% of the questions that were answered incorrectly by the under 14, under 15 and under 16 age groups and the open age group, respectively, indicate that the four age categories lack knowledge related to carbohydrates, which foods should form the basis of the daily diet, what is the key to healthy eating, what does a balanced diet entail and the importance of staying hydrated. Protein (chicken, fish, beans, eggs) and fruit and vegetables (apple, banana, spinach and carrots) were the two most popular choices for the question: ‘which food groups should be eaten the most each day’.

All four age groups further believed that diets consisting mostly of meat and vegetables are well-balanced diets. The under 14 (31.6%), under 15 (54.3%), under 16 (52.9%) and open (60.7%) age groups all responded with “all of the above” to the question regarding what healthy eating entails. Although all age groups understood that milk and yogurt are a good source of calcium, only 2.2% of the under 15’s, 5.9% of the under 16’s, 3.6% of the open age group and none of the under 14’s knew that pilchards are a good source of calcium. The latter responses could be indicative of a lack of in-depth nutrition knowledge among the players surveyed

Table 4.12 indicates the comparison of results from the final section of the general- and sports-related nutrition knowledge questionnaire between each age group.

Table 4.12: Comparison of knowledge generated from the final section of the general- and sports-related nutrition questionnaire between the age groups: under 14 (n=19); under 15 (n=46); under 16 (n=17) and open (n=28) (N=110)

Question	U14 % (n=19)	U15 % (n=46)	U16 % (n=17)	Open % (n=28)
Source of nutrition information (more than one option could be chosen):				
• Parents	68.4% (n=13)	58.7% (n=27)	52.9% (n=9)	39.3% (n=11)
• Media	31.6% (n=6)	47.8% (n=22)	47.1% (n=8)	53.6% (n=11)
• School	42.1% (n=8)	52.2% (n=24)	23.5% (n=4)	28.6% (n=8)
• Peers/ friends	15.8% (n=3)	34.8% (n=16)	29.4% (n=5)	39.3% (n=11)
• Other	5.3% (n=1)	13.0% (n=6)	23.5% (n=4)	14.3% (n=4)
Do you use nutritional supplements?				
• Yes	47.4% (n=9)	51.1% (n=23)	52.9% (n=9)	78.6% (n=22)
• No	52.6% (n=10)	48.9% (n=22)	47.1% (n=8)	21.4% (n=6)
Frequency of supplement use:				
• 3-4 times a week	11.1% (n=1)	26.1% (n=6)	11.1% (n=1)	40.9% (n=9)
• Daily	11.1% (n=1)	17.4% (n=4)	33.3% (n=3)	27.3% (n=6)
• Once or twice a week	33.3% (n=3)	21.7% (n=5)	33.3% (n=3)	9.1% (n=2)
• Less than weekly	11.1% (n=1)	21.7% (n=5)	11.1% (n=1)	22.7% (n=5)
• Once a week	33.3% (n=3)	13% (n=3)	11.1% (n=1)	-
Most frequently used supplement (more than one option could be chosen): (p= 0.000) #				
• Protein shake	5.3% (n=1)	37.0% (n=17)	35.3% (n=6)	64.3% (n=18)
• Energy drinks	31.6% (n=6)	15.2% (n=7)	17.6% (n=3)	17.9% (n=5)
• Meal replacements	10.5% (n=2)	6.5% (n=3)	11.8% (n=2)	17.9% (n=5)
• Mass builder	-	10.9% (n=5)	5.9% (n=1)	14.3% (n=4)
• Creatine	-	6.5% (n=3)	5.9% (n=1)	17.9% (n=5)
• Fat burner	-	2.2% (n=1)	17.6% (n=3)	10.7% (n=3)
• Amino acids	-	-	-	21.4% (n=6)
• Other	-	4.3% (n=2)	5.9% (n=1)	10.7% (n=3)
• Taking one but unsure what it is	10.5% (n=2)	-	-	-

Have you ever considered taking a non-food supplement to improve sporting performance or help achieve goals?				
• Yes	66.7% (n=12)	57.1% (n=24)	56.3% (n=9)	75.0% (n=21)
• No	33.3% (n=6)	42.9% (n=18)	43.8% (n=7)	25.0% (n=7)
Have you considered changing your diet to help achieve your goals?				
• Yes	57.9% (n=11)	59.5% (n=25)	76.5% (n=13)	85.2% (n=23)
• No	42.1% (n=8)	40.5% (n=17)	23.5% (n=4)	14.8% (n=4)
Dietary changes made (more than one option could be chosen):				
• Healthier food choices, no junk food	36.8% (n=7)	43.5% (n=20)	47.1% (n=8)	82.1% (n=23)
• Increased protein portions	26.3% (n=5)	41.3% (n=19)	52.9% (n=9)	71.4% (n=20)
• More veg and fruit	42.1% (n=8)		41.2% (n=7)	46.4% (n=13)
• Cut out snacking between meals	21.1% (n=4)	37.0% (n=17)	23.5% (n=4)	28.6% (n=8)
• Decreased carb portions	5.3% (n=1)	17.4% (n=8)	23.5% (n=4)	35.7% (n=10)
• Planned snacks around exercise	15.8% (n=3)	21.7% (n=10)	23.5% (n=4)	17.9% (n=5)
• Increased carb portions	26.3% (n=5)	15.2% (n=7)	29.4% (n=5)	17.9% (n=5)
• Included snacks between meals	5.3% (n=1)	15.2% (n=7)	-	7.1% (n=2)
• Other	-	2.2% (n=1)	-	3.6% (n=1)
• Decreased protein portions	-	2.2% (n=1)	-	-
		2.2% (n=1)		
Rate the importance of exercise or practice sessions to your overall performance:	68.4% (n=13)	65.2% (n=30)	76.5% (n=13)	66.7% (n=18)
• Critical, can't achieve without it	26.3% (n=5)	21.7% (n=10)	23.5% (n=4)	33.3% (n=9)
• Very important	5.3% (n=1)	6.5% (n=3)	-	-
• Fairly important	-	6.5% (n=3)	-	-
• Helps a little	-	-	-	-
Rate the importance of gym or weight training to your overall performance:				
• Very important	21.1% (n=4)	28.9% (n=13)	50% (n=8)	57.1% (n=16)
• Fairly important	47.4% (n=9)	37.8% (n=17)	25% (n=4)	17.9% (n=5)
• Critical, can't achieve without it	21.1% (n=4)	15.6% (n=7)	12.5% (n=2)	3.6% (n=1)
• Helps a little	-	15.6% (n=7)	12.5% (n=2)	17.9% (n=5)
• Not important	10.5% (n=2)	2.2% (n=1)	-	3.6% (n=1)
Rate the importance of diet/ what you eat to your overall performance:				

• Critical, can't achieve without it	42.1% (n=8)	44.4% (n=20)	41.2% (n=7)	57.1% (n=16)
• Very important	42.1% (n=8)	33.3% (n=15)	35.3% (n=6)	35.7% (n=10)
• Fairly important	5.3% (n=1)	15.6% (n=7)	17.6% (n=3)	3.6% (n=1)
• Helps a little	10.5% (n=2)	4.4% (n=2)	5.9% (n=1)	3.6% (n=1)
• Not important	-	2.2% (n=1)	-	-
Rate the importance of rest to your overall performance:				
• Critical, can't achieve without it	52.6% (n=10)	47.8% (n=22)	47.1% (n=8)	64.3% (n=18)
• Very important	36.8% (n=7)	23.9% (n=11)	35.3% (n=6)	17.9% (n=5)
• Fairly important	10.5% (n=2)	21.7% (n=10)	5.9% (n=1)	7.1% (n=2)
• Helps a little	-	4.3% (n=2)	5.9% (n=1)	7.1% (n=2)
• Not important	-	2.2% (n=1)	5.9% (n=1)	3.6% (n=1)
Rate the importance of supplements to your overall performance:				
• Not important	31.6% (n=6)	46.7% (n=21)	41.2% (n=7)	10.7% (n=3)
• Helps a little	36.8% (n=7)	28.9% (n=13)	29.4% (n=5)	28.6% (n=8)
• Fairly important	21.1% (n=4)	13.3% (n=6)	17.6% (n=3)	25.0% (n=7)
• Very important	10.5% (n=2)	11.1% (n=5)	11.8% (n=2)	32.1% (n=9)
• Critical, can't achieve without it	-	-	-	3.6% (n=1)
Can carbohydrate-rich foods eaten before, during or after training affect performance?				
• Yes	63.2% (n=12)	42.2% (n=19)	56.3% (n=9)	75.0% (n=21)
• I don't know	26.3% (n=5)	37.8% (n=17)	43.8% (n=7)	21.4% (n=6)
• No	10.5% (n=2)	20% (n=9)	-	3.6% (n=1)
Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure?				
• No	84.2% (n=16)	97.7% (n=43)	93.8% (n=15)	82.1% (n=23)
• Yes	15.8% (n=3)	2.3% (n=1)	6.3% (n=1)	17.9% (n=5)
Are you using a pre-workout supplement?				
• No	94.4% (n=17)	80.4% (n=37)	88.2% (n=15)	67.9% (n=19)
• Yes	5.6% (n=1)	19.6% (n=9)	11.8% (n=2)	32.1% (n=9)
Pre-workout supplement brand:				
• I don't know	-	12.5% (n=1)	50% (n=1)	10% (n=1)
• Whey powder	-	37.5% (n=3)	-	-

• No-name brand	-	12.5% (n=1)	-	10% (n=1)
• Evox	-	12.5% (n=1)	-	10% (n=1)
• Beast mode	-	-	-	20% (n=2)
• ECA-stack	-	-	-	10% (n=1)
• Ensure	100% (n=1)	-	-	-
• ECA	-	-	-	10% (n=1)
• Gaterade	-	-	-	10% (n=1)
• Boot extreme	-	-	-	10% (n=1)
• USN explode	-	-	-	10% (n=1)
• USN	-	12.5% (n=1)	-	-
• Futurelife	-	12.5% (n=1)	-	-
• Bullknox	-	-	50% (n=1)	-
When is it most important to eat carbohydrate rich foods?				
• Before training	44.4% (n=8)	70.5% (n=31)	52.9% (n=9)	81.5% (n=22)
• After training	50% (n=9)	27.3% (n=12)	47.1% (n=8)	18.5% (n=5)
• During training	5.6% (n=1)	2.3% (n=1)	-	-

#: Chi-squared test showing statistical significance for the type of supplement most frequently used from under 14 age group to open age group.

A statistically significant difference regarding the supplement most frequently used was documented across age groups surveyed as per Table 4.12 above. Trends observed were that amongst the four age groups: (i) more than 50% of the under 14, under 15 and under 16 age groups obtained their nutrition information from their parents whilst 53.6% of the open age group obtained their nutrition information from the media; (ii) 51.1%, 52.9% and 78.6% of the under 15's, under 16's and opens, respectively, indicated that they are using a nutritional supplement with the majority of each age group using it 3-4 times a week, while an equal number of under 16's used supplements once or twice a week. The most popular supplement choice was a protein shake. 52.6% of the under 14 age group were not using a nutritional supplement; (iv) 66.7%, 57.1%, 56.3% and 75.0% of the under 14, under 15, under 16 and opens age group respectively, would consider taking a non-food supplement that may help them achieve their sporting goals; (v) all four age groups: under 14 (57.9%), under 15 (59.5%), under 16 (76.5%) and open (85.2%) have made changes to their diets to help them achieve their goals.

The most popular changes being: healthier food choices and less junk food, increasing the protein in the diet and eating more vegetables and fruit; (vi) all four age groups considered exercise/ practice sessions, diet and rest as critical to their overall performance while the under 14 and under 15 age group felt gym and weight training in fairly important and the under 16 and open age group felt gym and weight training was very important to their overall performance.

Finally the under 15 and under 16 age groups felt supplements were not important, while the under 14's felt supplements help a little and the open age group felt supplements were very important to their overall success; (vii) all four age groups understood that carbohydrates can affect their performance but a large proportion of the under 14's, under 15's, under 16's and open age groups (26.3%, 37.8%, 43.8% and 21.4%) answered that they didn't know; (viii) more than 80% of each age group said that they are not using a supplement that may have negative side effects and 94.4%, 80.4%, 88.2% and 67.9% of the under 14's, under 15's, under 16's and opens, respectively, are not using a pre-workout supplement; (ix) the majority of only the under 14 age group (50%) understood that eating carbohydrates is most important after exercising.

4.2.5 The comparison of general- and sports-related nutrition knowledge between the open age group (n=28) and the other three age groups (under 14, under 15 and under 16 (n=82)).

Table 4.13 compares the characteristics of the study sample between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82).

Table 4.13: Comparing the characteristics of the study sample between the open age group (n=28) and the non-open age groups: under 14; under 15 and under 16 (n=82) (N=110)

Variable *	Open % (n=28)	Non-open % (n=82)
Age (years): • Mean ± std. deviation (p=0.000)#	17.25 ± 0.844	14.52 ± 0.773
Race: • White • African • Indian • Coloured	 85.7% (n=24) 14.3% (n=4) - -	 76.5% (n=62) 21% (n=17) 1.2% (n=1) 1.2% (n=1)
Accommodation: • Border • Day scholar	 66.7% (n=18) 33.3% (n=9)	 71.3% (n=57) 28.8% (n=23)
Team: • First • Second • Third • Fourth • Under 16A • Under 16B • Under 16C • Under 15A • Under 15B • Under 15C • Under 15D • Under 14A • Under 14B • Under 14C	 39.3% (n=11) 10.7% (n=3) 32.1% (n=9) 17.9% (n=5)	 8.5% (n=7) 9.8% (n=8) 2.4% (n=2) 12.2% (n=10) 13.4% (n=11) 15.9% (n=13) 14.6% (n=12) 12.2% (n=10) 6.1% (n=5) 4.9% (n=4)
Position in the team: Forwards: • Flank • Lock • Prop • Hooker • Eighth man • Loose forward	 14.3% (n=4) 14.3% (n=4) 21.4% (n=6) 10.7% (n=3) 3.6% (n=1) 3.6% (n=1)	 17.1% (n=14) 15.9% (n=13) 9.8% (n=8) 8.5% (n=7) 3.7% (n=3) -

Backs: • Wing • Scrumhalf • Inside centre • Fullback • Flyhalf • Outside centre	3.6% (n=1) 7.1% (n=2) 7.1% (n=2) 3.6% (n=1) 3.6% (n=1) 7.1% (n=2)	12.2% (n=10) 7.3% (n=6) 7.3% (n=6) 8.5% (n=7) 6.1% (n=5) 3.7% (n=3)

#: Chi-square test shows statistically significant result

A statistically significant difference (p=0.000) was seen between the mean ages of the open age group (17.25) and non-open age category (14.52). The trends in the characteristics of the open age groups and non-open age categories do not differ much from the characteristics of the overall study sample. The Indian (n=1) and African (n=1) participants are represented by the non-open age category. The majority of both age group categories are white and borders at the school.

Table 4.14 represents the comparison of results in the true and false section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82).

Table 4.14: The comparison of results generated from the true and false section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82) (N=110)

Question *	**Open**		**Non-open**	
		% (n=28)		**% (n=82)**
You should eat a lot of sugar to have enough energy: (p=0.019)#	• False • True	100% (n=28) -	• False • True	82.9% (n=68) 17.1% (n=14)
You should add extra salt to your cooked food before you eat it:	• False • True	82.1% (n=23) 17.9% (n=5)	• False • True	79.3% (n=65) 20.7% (n=17)
If you are eating a healthy diet there is no need for you to be physically active:	• False • True	96.4% (n=27) 3.6% (n=1)	• False • True	96.3% (n=79) 3.7% (n=3)
All water is safe to drink	• False • True	96.4% (n=27) 3.6% (n=1)	• False • True	90.2% (n=74) 9.8% (n=8)
Your body only needs a little bit of salt to be healthy:	• True • False	75.0% (n=21) 25.0% (n=7)	• True • False	76.8% (n=63) 23.2% (n=19)
Sugar and foods that contain sugar should be eaten in small amounts:	• True • False	96.4% (n=27) 3.6% (n=1)	• True • False	84.1% (n=69) 15.9% (n=13)
Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods:	• True • False	60.7% (n=17) 39.3% (n=11)	• True • False	61% (n=50) 39% (n=32)
Sugar contains a lot of vitamins and minerals: (p=0.007)#	• False • True	100% (n=28) -	• False • True	78% (n=64) 22% (n=18)
It is impossible to get all the vitamins and minerals you need from food, you need to take a vitamin and mineral pill:	• False • True	71.4% (n=20) 28.6% (n=8)	• False • True	76.8% (n=63) 23.2% (n=19)
Starchy foods should not be eaten when one is trying to lose weight:	• True • False	57.1% (n=16) 42.9% (n=12)	• True • False	51.9% (n=42) 48.1% (n=39)
Eating bread always causes weight gain:	• False • True	50.0% (n=14) 50.0% (n=14)	• False • True	65.9% (n=54) 34.1% (n=28)
It is healthy to snack on foods that contain a lot of sugar:	• False • True	96.4% (n=27) 3.6% (n=1)	• False • True	81.7% (n=67) 18.3% (n=15)
You can eat as much meat as you want every day:	• False • True	60.7% (n=17) 39.3% (n=11)	• False • True	68.3% (n=56) 31.7% (n=26)
Dry beans, peas, lentils are a healthy choice to eat in place of meat:	• True • False	60.7% (n=17) 39.3% (n=11)	• True • False	57.3% (n=47) 42.7% (n=35)
I supplement my diet with food items/ alternatives:	• False • True	59.3% (n=16) 40.7% (n=11)	• False • True	52.4% (n=43) 47.6% (n=39)
It is necessary to supplement your diet (use supplements) to build mass:	• False • True	67.9% (n=19) 32.1% (n=9)	• False • True	73.2% (n=60) 26.8% (n=22)

Fats are necessary in your diet as they provide additional energy and vitamins:	• True • False	89.3% (n=25) 10.7% (n=3)	• True • False	87.8% (n=72) 12.2% (n=10)
There is a difference between good and bad fats in food: (p=0.041)#	• True • False	100% (n=28) -	• True • False	86.6% (n=71) 13.4% (n=11)
Pre- workout meals/ drinks should contain carbohydrates:	• True • False	82.1% (n=23) 17.9% (n=5)	• True • False	76.3% (n=61) 23.8% (n=19)
Caffeinated energy drinks are necessary for an energy boost before practice or a game:	• False • True	78.6% (n=22) 21.4% (n=6)	• False • True	84.1% (n=69) 14.6% (n=12)
There is a difference between a sport drink and an energy drink:	• True • False	85.7% (n=24) 14.3% (n=4)	• True • False	72% (n=59) 28% (n=23)
My diet changes between pre, during and post season: (p=0.051)#	• True • False	67.9% (n=19) 32.1% (n=9)	• False • True	57.3% (n=47) 41.5% (n=34)
What I eat affects my performance, recovery and body composition more than additional supplements:	• True • False	85.7% (n=24) 14.3% (n=4)	• True • False	76.5% (n=62) 23.5% (n=19)
Post workout meals/ drinks should contain carbohydrates:	• True • False	57.1% (n=16) 42.9% (n=12)	• True • False	66.7% (n=54) 32.1% (n=26)

#: Chi-square test shows statistically significant result

There are four instances of statistically significant results seen between the two age categories in table 4.14: “You should eat a lot of sugar to have enough energy” (p=0.019); “Sugar contains a lot of vitamins and minerals” (p=0.007); “There is a difference between good and bad fats in food” (p=0.041) and “My diet changes between pre, during and post season” (p=0.051).

Both the open age group and the non-open age category presented a general- and sports-related nutrition knowledge of 95% in the first section of the questionnaire indicating that they have an adequate general- and sports-related nutrition knowledge. The questions that resulted in 5% of the score being deducted indicate that the knowledge area of concern for both the age categories is carbohydrates. The answers to the true and false section of the general- and sports-related nutrition knowledge questionnaire by the open age group and non-open age categories trend in a similar way.

Both the open age group (57.1%) and non-open age category (51.9%) believe that starchy foods should not be eaten when trying to lose weight. The open age group was split evenly (50%) between their belief as to whether eating bread always causes

weight gain. 59.3% as opposed to 52.4% of the open age group and non-open age category said that they supplement their diet with nutritional supplements. A larger 21.4% of the open age group in comparison to 14.6% of the non-open age category believe that caffeinated beverages are necessary to provide energy before a practice or game. Finally, a larger 67.9% of the open age group as opposed to 57.3% of the non-open age category suggested that their diets change between seasons.

Table 4.15 indicates the comparison of results generated by the multiple choice section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82).

Table 4.15: The comparison of results generated from the multiple choice section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82) (N=110)

Question	**Open% (n=28)**	**Non-open% (n=82)**	**P-value** #
You should not have starches at most meals because:			
• None of the above	42.9% (n=12)	56.1% (n=46)	0.051#
• Cause weight gain	50.0% (n=14)	23.2% (n=19)	
• Not important for health	7.1% (n=2)	12.5% (n=10)	
• Cause disease	-	6.1% (n=5)	
How much water should you drink a day?			
• 7-9 glasses	50% (n=14)	50% (n=41)	
• 4-6 glasses	50% (n=14)	40.2% (n=33)	
• 1-3 glasses	-	7.3% (n=6)	
• Don't have to drink water everyday	-	2.4% (n=2)	
Which of the following is a low fat snack:			
• Popcorn	92.9% (n=26)	65.9% (n=54)	0.042#
• Niknaks	7.1% (n=2)	18.3% (n=15)	
• Simba chips	-	9.8% (n=8)	
• Fried chips	-	6.1% (n=5)	
From which food group should you eat the most every day?			
• Chicken, fish, beans, eggs	46.4% (n=13)	45.7% (n=37)	
• Apple, banana, spinach, carrots	39.3% (n=11)	44.4% (n=36)	
• Bread, samp, rice, porridge	10.3% (n=3)	8.6% (n=7)	
• Milk, yogurt, cheese	3.6% (n=1)	1.2% (n=1)	
Key to healthy eating is to:			
• All of the above	60.7% (n=17)	48.8% (n=40)	
• Certain foods in small/ moderate amounts	35.7% (n=10)	26.8% (n=22)	
• Many different kinds of foods	3.6% (n=1)	12.2% (n=10)	
• Some foods more than others	-	12.2% (n=10)	
Which foods contain a lot of calcium?			
• Milk, yogurt	75.0% (n=21)	60.5% (n=49)	
• Chicken and eggs	21.4% (n=6)	3.7% (n=3)	
• Pilchards	3.6% (n=1)	2.5% (n=2)	
• Milk, yogurt and pilchards	-	33.3% (n=27)	
Being physically active means:			
• all of the above	100% (n=28)	92.7% (n=76)	
• playing sports	-	6.1% (n=5)	
• going to gym	-	1.2% (n=1)	
How many fruits and vegetables should be eaten on a daily basis			
• 3-4/ day	75.0% (n=21)	58% (n=47)	
• More than 5/ day	14.3% (n=4)	28.4% (n=23)	
• 1/ day	7.1% (n=2)	12.3% (n=10)	

• No need to eat fruit and veg daily	3.6% (n=1)	1.2% (n=1)	
How much milk or maas should be consumed per day? • 1 cup • 2 cups • Half a cup • None	 67.9% (n=19) 32.1% (n=9) - -	 39.5% (n=32) 44.4% (n=36) 11.1% (n=9) 4.9% (n=4)	 0.032#
A well balanced diet consists of: • Mostly meat • Mostly veg • None of the above • Mostly starch, veg and fruit	 33.3% (n=9) 33.3% (n=9) 14.8% (n=4) 18.5% (n=5)	 40.7% (n=33) 33.3% (n=27) 14.8% (n=12) 11.1% (n=9)	
Which of the following breakfast menus are low in fat? • Weet-bix with 2% milk and whole-wheat toast with little margarine • Weet-bix with 2% milk • Bacon and egg • Whole-wheat toast with little margarine	 64.3% (n=18) 17.9% (n=5) 10.3% (n=3) 7.1% (n=2)	 49.4% (n=40) 32.1% (n=26) 13.6% (n=11) 4.9% (n=4)	
Which food contains the most fibre? • Whole-wheat bread • Brown bread • What is fibre? • White bread	 70.4% (n=19) 14.8% (n=4) 3.7% (n=1) 11.1% (n=3)	 60% (n=48) 21.3% (n=17) 12.5% (n=10) 6.3% (n=5)	
The reason why beans, peas and lentils are good for you is that: • All of the above • Contain little fat • Contain high fibre • Can protect from disease	 67.9% (n=19) 17.9% (n=5) 7.1% (n=2) 7.1% (n=2)	 54.3% (n=44) 22.2% (n=18) 18.5% (n=15) 4.9% (n=4)	
It is important to stay hydrated: • Before, during and after exercise • During and after exercise • After exercise • During exercise	 75.0% (n=21) 10.7% (n=3) 14.3% (n=4) -	 82.9% (n=68) 11% (n=9) 4.9% (n=4) 1.2% (n=1)	
The following energy drinks contain caffeine: • All of the above • Red bull • Monster	 81.5% (n=22) 3.7% (n=1) 14.8% (n=4)	 95.1% (n=77) 2.5% (n=2) 2.5% (n=2)	 0.048#
Correct beverage to drink during a workout is: • Powerade • Coca Cola • All of the above • Monster	 96.2% (n=25) 3.8% (n=1) - -	 90.1% (n=73) 6.2% (n=5) 2.5% (n=2) 1.2% (n=1)	

#: Chi-square test shows statistically significant result

Four instances of statistically significantly different results between the open age group and non-open age category can be seen in table 4.15 above: choosing the correct

response to why starches should not be eaten at most meals (p=0.051); determining what a low fat snack is (p=0.042); deciding how much milk, maas or yogurt should be consumed per day (p=0.032) and finally the understanding of which energy drinks contain caffeine (p=0.048).

The open age group scored 62.5% in the multiple choice section of the general- and sports-related nutrition knowledge questionnaire, whilst the non-open age category scored 67.8%. These results indicate that both age categories have an adequate general- and sports-related nutrition knowledge. The remaining 32.3% and 37.5% of the questions that were answered incorrectly by the non-open age category and the open age group, respectively, indicate that both age categories lack knowledge related to carbohydrates, which foods should form the basis of the daily diet, what is the key to healthy eating, what does a balanced diet entail and the importance of staying hydrated.

Interestingly 50% of the open age group as opposed to 23.2% of the non-open age category believe starches should not be eaten at most meals as they cause weight gain. Similar trends seen between the open age group and non-open category that stand out are highlighted. 46.4% and 45.7% of the open age group and non-open age category, respectively, incorrectly believed that chicken, fish, beans and eggs make up the food group from which the most should be eaten every day. A very large 60.7% of the open age group answered “all of the above” when questioned about what healthy eating entails. The same answer was given by 48.8% of the non-open age category. 33.3% of the open age group and non-open age category believe that (i) a diet should consist of mostly meat and (ii) 33.3% of the open age group in comparison to 40.7% believe that a diet should consist of mostly vegetables.

Table 4.16 compares the results generated by the final section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups. This section includes aspects such as: (i) sources of nutrition knowledge; (ii) supplement usage and type of supplements chosen most often; (iii) the type of changes made to their diet help achieve their overall goals and (iv) testing the concept of carbohydrate timing.

Table 4.16: The comparison of the results generated from the final section of the general- and sports-related nutrition knowledge questionnaire between the open age group (n=28) and the non-open age groups: under 14; under and under 16 (n=82) (N=110)

Question	**Open % (n=28)**	**Non-open % (n=82)**	**P-value** #
Source of nutrition information (more than one option could be chosen):			
• Parents	39.3% (n=11)	59.8% (n=49)	
• Media	53.6% (n=11)	43.9% (n=36)	
• School	28.6% (n=8)	43.9% (n=36)	0.043#
• Peers/ friends	39.3% (n=11)	29.3% (n=24)	
• Other	14.3% (n=4)	13.4% (n=11)	
Do you use nutritional supplements?			
• Yes	78.6% (n=22)	50.6% (n=41)	0.010#
• No	21.4% (n=6)	49.4% (n=40)	
Frequency of supplement use:			
• 3-4 times a week	40.9% (n=9)	19.5% (n=8)	
• Daily	27.3% (n=6)	19.5% (n=8)	
• Once or twice a week	9.1% (n=2)	26.8% (n=11)	
• Less than weekly	22.7% (n=5)	17.1% (n=7)	
• Once a week	-	17.1% (n=7)	
Most frequently used supplement (more than one option could be chosen):			
• Protein shake	64.3% (n=18)	29.3% (n=24)	
• Energy drinks	17.9% (n=5)	19.5% (n=16)	
• Meal replacements	17.9% (n=5)	8.5% (n=7)	
• Mass builder	14.3% (n=4)	7.3% (n=6)	
• Creatine	17.9% (n=5)	4.9% (n=4)	
• Fat burner	10.7% (n=3)	4.9% (n=4)	
• Amino acids	21.4% (n=6)	-	0.000#
• Other	10.7% (n=3)	3.7% (n=3)	
• Taking one but unsure what it is	-	2.4% (n=2)	
Have you ever considered taking a non-food supplement to improve sporting performance or help achieve goals?			
• Yes	75.0% (n=21)	59.2% (n=45)	
• No	25.0% (n=7)	40.8% (n=31)	
Have you considered changing your diet to help achieve your goals?			
• Yes	85.2% (n=23)	62.8% (n=49)	0.031#
• No	14.8% (n=4)	37.2% (n=29)	
Dietary changes made (more than one option could be chosen):			
• Healthier food choices, no junk food	82.1% (n=23)	42.7% (n=35)	
• Increased protein portions	71.4% (n=20)	40.2% (n=33)	
• More veg and fruit	46.4% (n=13)	39% (n=32)	

• Cut out snacking between meals	28.6% (n=8)	19.5% (n=16)	
• Decreased carb portions	35.7% (n=10)	18.3% (n=15)	
• Planned snacks around exercise	17.9% (n=5)	17.1% (n=14)	
• Increased carb portions	17.9% (n=5)	20.7% (n=17)	
• Included snacks between meals	7.1% (n=2)	2.4% (n=2)	
• Other	3.6% (n=1)	1.2% (n=1)	
• Decreased protein portions	-	1.2% (n=1)	
Rate the importance of exercise or practice sessions to your overall performance:			
• Critical, can't achieve without it	66.7% (n=18)	68.3% (n=56)	
• Very important	33.3% (n=9)	23.2% (n=19)	
• Fairly important	-	4.9% (n=4)	
• Helps a little	-	3.7% (n=3)	
Rate the importance of gym or weight training to your overall performance:			
• Very important	57.1% (n=16)	31.3% (n=25)	0.052#
• Fairly important	17.9% (n=5)	37.5% (n=30)	
• Critical, can't achieve without it	3.6% (n=1)	11.3% (n=9)	
• Helps a little	17.9% (n=5)	16.3% (n=13)	
• Not important	3.6% (n=1)	3.8% (n=3)	
Rate the importance of diet/ what you eat to your overall performance:			
• Critical, can't achieve without it	57.1% (n=16)	43.2% (n=45)	
• Very important	35.7% (n=10)	35.8% (n=29)	
• Fairly important	3.6% (n=1)	13.6% (n=11)	
• Helps a little	3.6% (n=1)	6.2% (n=5)	
• Not important	-	1.2% (n=1)	
Rate the importance of rest to your overall performance:			
• Critical, can't achieve without it	64.3% (n=18)	48.8% (n=40)	
• Very important	17.9% (n=5)	29.3% (n=24)	
• Fairly important	7.1% (n=2)	15.9% (n=13)	
• Helps a little	7.1% (n=2)	3.7% (n=3)	
• Not important	3.6% (n=1)	2.4% (n=2)	
Rate the importance of supplements to your overall performance:			
• Not important	10.7% (n=3)	42% (n=34)	0.004#
• Helps a little	28.6% (n=8)	30.9% (n=25)	
• Fairly important	25.0% (n=7)	16% (n=13)	
• Very important	32.1% (n=9)	11.1% (n=9)	
• Critical, can't achieve without it	3.6% (n=1)	-	
Can carbohydrate-rich foods eaten before, during or after training affect performance?			
• Yes	75.0% (n=21)	50% (n=40)	
• I don't know	21.4% (n=6)	36.3% (n=29)	
• No	3.6% (n=1)	13.8% (n=11)	
Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure?			
• No	82.1% (n=23)	93.7% (n=74)	

• Yes	17.9% (n=5)	6.3% (n=5)	
Are you using a pre-workout supplement?			
• No	67.9% (n=19)	85.2% (n=69)	0.045#
• Yes	32.1% (n=9)	14.8% (n=12)	
Pre-workout supplement brand:			
• I don't know	10% (n=1)	18.2% (n=2)	
• Whey powder	-	27.3% (n=3)	
• No-name brand	10% (n=1)	9.1% (n=1)	
• Evox	10% (n=1)	9.1% (n=1)	
• Beast mode	20% (n=2)	-	
• ECA-stack	10% (n=1)	-	
• Ensure	-	9.1% (n=1)	
• ECA	10% (n=1)	-	
• Gaterade	10% (n=1)	-	
• Boot extreme	10% (n=1)	-	
• USN explode	10% (n=1)	-	
• USN	-	9.1% (n=1)	
• Futurelife	-	9.1% (n=1)	
• Bullknox	-	9.1% (n=1)	
When is it most important to eat carbohydrate rich foods?			
• Before training	81.5% (n=22)	60.8% (n=48)	
• After training	18.5% (n=5)	36.7% (n=29)	
• During training	-	2.5% (n=2)	

#: Chi-square test shows statistically significant result

Several statistically significant differences between the open age group and non-open age category can be seen in table 4.16 above: the non-open age group relies on school as the source of nutrition information statistically significantly less than the non-open age group (p=0.043); the use of nutritional supplements (p=0.010); amino acid supplement use (p=0.000); changes made to the diet to help achieve their goals (p=0.031); the importance of gym or weight training to achieving their overall goals (p=0.052); the importance of supplements to achieving their goal (p=0.004) and the use of a pre-workout supplement (p=0.045).

Several trends can be seen between the open age group and the non-open age category; (i) media was selected as the most popular source of nutrition information for the open age group (53.6%), this differed to the open age category of which parents and school were selected as the most popular; (ii) 50.6% of the non-open age category indicated that they are using a nutritional supplement. A much larger percentage of the open age group (78.6%) indicated to be using a nutritional supplement. The open age group also use it the most often with 40.9% of them using their supplements 3-4

times a week and 27.3% using their supplements on a daily basis (as opposed to once or twice a week being the most popular for the other age category). 17.9% of the open age group said that they use creatine (as opposed to less than 10% for the other three age groups), 21.4% said they use amino acids (as opposed to less than 5% for the non-open age category) and a large 64.3% selected protein shakes as their supplement of choice (as opposed to less than 40% for the non-open age category); (iii) 75% of the open age group selected that they would in fact consider the use of a non-food supplement if it would help the achieve their goals, with 59.2% of the non-open age category suggesting that they would consider the use of these supplements; (iv) 62.8% of the non-open age category have made changes to their diet to help achieve their goals.

Again the highest result was seen from the open age group with 85.2% suggesting that they have made changes to their dietary habits to help achieve their goals. With a large 71.4% of the open age group selecting the change of increasing the protein portions in their diet (as opposed to 40.2% for the non-open age category); (v) more than 50% of the open age group, only, consider gym/ weight training to be very important towards their overall success. A high 32.1% of the open age group also consider supplements to be very important in helping them achieve their goals (only 11.1% of the non-open age category selected “very important” regarding the use of supplements toward achieving their goals).

The open age group was also the only one with more than 50% believing diet is critical to their achievement and success; (vi) 75% of the opens, as opposed to 50% of the non-open age category, understand that carbohydrates and the timing of carbohydrates are important and can affect their overall performance. Interestingly and inaccurately, only 18.5% of the opens, as opposed to 36.7% of the non-open age category consider carbohydrates after exercise to be the most important portion of carbohydrates; finally (vii) 32.1% of the open age group take a pre-workout supplement. This is high when comparing it to the non-open age group which only made up 14.8%.

4.2.6 The possible progression of general- and sports-related nutrition knowledge from the under 14 age group to the open age group.

Table 4.17 indicates a possible progression of general- and sports-related nutrition knowledge from the under 14 age group to the open age group.

Table 4.17: Comparison of the descriptive statistics indicating a possible progression of general- and sports-related nutrition knowledge from the under 14 age group to open age group (N=110)

Variable*	**% (n)**	**Mean ± SD % (n)**	**Minimum % (n)**	**Maximum % (n)**
U14	17.3 (n=19)	63.3 ± 9.2 (n=25.3 ± 3.8)	47.5 (n=19)	82.5 (n=33)
U15	41.8 (n=46)	65.8 ± 9.4 (n=26.3 ± 3.7)	40 (n=16)	80 (n=32)
U16	15.5 (n=17)	64.0 ± 7.8 (n=25.6 ± 3.1)	42.5 (n=17)	75 (n=30)
Open	25.5 (n=28)	67.7 ± 10.5 (n=27.1 ± 3.9)	50 (n=20)	82.5 (n=32)

* no statistically significant in the progression of knowledge across age groups

From Table 4.17 above it is evident that the mean score of the general- and sports-related nutrition knowledge for all four age groups was above 60%. The under 14's (63.3%), under 15's (65.8%), under 16's (64.0%) and open age groups (67.7%) therefore seemingly had an acceptable level of general- and sports-related nutrition knowledge. Whilst there was a progression of general- and sports-related nutrition knowledge observed from under 14 age group to the open age group, it is only a 5% increase. There was also no statistically significant difference found in the progression of knowledge from the under 14 age group to the open age group.

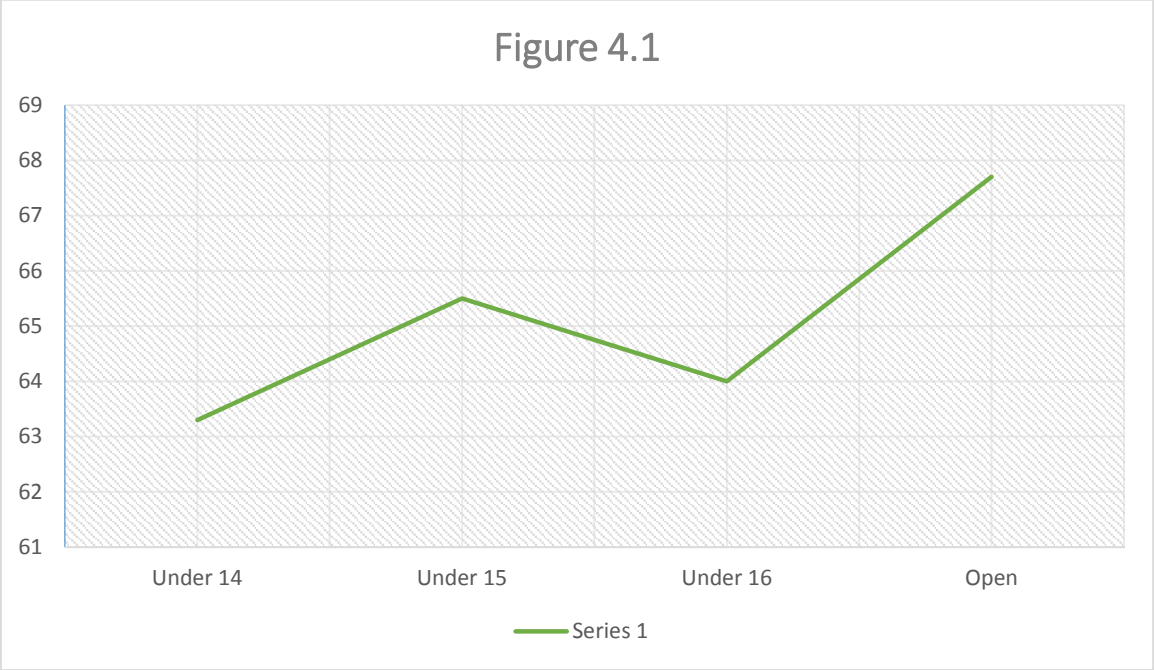

Figure 4.1: Graph depicting the progression of mean nutrition score (%) score in the general- and sports-related nutrition knowledge questionnaire from the under 14 age group to the open age group.

4.3 Summary

Overall the results depict that the adolescent rugby players at the urban, government, secondary school in Pietermaritzburg with whom the study was conducted have an adequate general- and sports-related nutrition knowledge. There are areas of concern regarding carbohydrates, protein and understanding of what healthy eating entails and well-balanced diets. No statistically specific results were seen when comparing the results of the general- and sports-related nutrition knowledge between the forward and backline players. Some trends concurrent with habits and patterns of the forwards and backline players were noticed. No statistically significant results were seen between the general- and sports-related nutrition knowledge of the under 14 age group to the open age groups but a slight progression of knowledge is seen. The open age group also presented trends that differed somewhat to those seen in the other three age groups.

In chapter 5 which follows; the results with respect to and in comparison to relevant and comparable literature will be discussed.

CHAPTER 5: DISCUSSION

5.1 Introduction

With the global rise in popularity of the high-risk, impact game of rugby, where participation starts at school level, sound general- and sports-related nutrition knowledge in adolescent athletes is of importance in order to achieve their sporting goals and maintain current and future health and success (Walsh *et al* 2011, Strachan 2009). Unfortunately Webb & Beckford (2013) and Burkhart (2010) highlight the paucity of published data on the general- and sports-related nutrition knowledge of adolescent athletes. However the data available on general scholar nutrition knowledge was used as a secondary option of comparison as all the rugby players that participated were primarily scholars. The aim of this study was to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending a boy's only urban secondary government school in Pietermaritzburg, KwaZulu-Natal. In addition, the study also aimed to document the use of nutritional and non-nutritional supplements among the study sample, as well as their source of nutrition information and supplement use.

5.2 Characteristics of study sample

The mean age of the study sample (N=110) was 15 years, with a minimum age of 13 years and a maximum age of 19 years. Hence the recorded age range lay within the parameters of what is described as adolescence (Weichselbaum & Buttriss 2014, Webb & Beckford 2013; Burkhart 2010), as this period of growth collectively involves the ages between 11 and 21 years.

The majority of the study sample were borders at the school they attended. This may have been because access to the school hall during after-school hours to participate in the study would have been easier than for day scholars who would've had to rely on their mode of transport waiting for them to complete the questionnaire. The results depicted the highest degree of participation by the under 15 side, collectively. The under 14 and first team also contributed around 9 and 10 percent of the sample, respectively. Players in the frontline positions including: prop, hooker, lock and flanker

as well as the players in the wing position had the highest participation rate in the study sample. Taking into account that each age group and position is represented by the same number of scholars within the school these results were not expected.

Data collection was being held over the exam period, this may have affected the total sample size and participation rates in numerous ways. Senior scholars are only required to come to school on the days and times they are required to write exams for their chosen subjects, although junior scholars are required to come to school every day, some may have been writing exams during the process of data collection. The rugby director at the school who oversaw the data collection only made an intercom announcement to the rugby players to attend the meeting, there was no face-to- face communication and invite. Thus this may have given the scholars a chance to decide whether to attend or not, depending on their enthusiasm for a rugby meeting after a day of studying and/ or writing exams. The higher participation rates from the under 14a and under 15 teams could be concomitant with the requirement of the juniors to be at school and their enthusiasm to be taken seriously by their coaches.

The high participation by the first team could be associated with their known responsibilities as the leaders of the school rugby. The overall low participation rate (22%) may have been caused by all of the above but all these boys are exposed to the same amount of nutrition education at the school and in their respective rugby teams which could lead to the proposed question that perhaps similar trends would have been seen throughout the total number of rugby players in the school. The results of the study sample descriptives depicted the highest participation rate came from white boys, followed by a low 21% from black boys and finally only one participant from Indian and coloured races, respectively. These results correlate to the racial breakdown of the 500 rugby players at the urban secondary school involved in the study.

5.3 Observed trends in the general- and sports-related nutrition knowledge of the study sample

From the results obtained, it was evident that study participants have an adequate general- and sports-related nutrition knowledge (the mean score for section A was

95% and 62.5% for section B). These scores were higher than that reported by Walsh *et al* (2011) where the mean general- and sports-related nutrition knowledge score of 203 Irish adolescent rugby players was 59.6%. Burkhart (2010) conducted a study in New Zealand that tested the general- and sports-related nutrition knowledge of 100 adolescent athletes (football, hockey, netball and rugby) and also found that the study sample had a reasonable basic nutrition knowledge. This was based on the fact that among rugby players, 63.2% of the general nutrition knowledge section was answered correctly, while 42.3% of the sports nutrition section was answered correctly. Contrary to the above findings, a study conducted by Webb & Beckford (2013) on 220 adolescent swimming club members from Trinidad and Tobago, found swimmer nutrition knowledge to be unsatisfactory.

These findings are similar to that reported among college athletes (Rodriguez 2012; Ozdoğan & Ozcelik 2011). Sichert-Hellert, Beghin, De Henauw, Grammatikaki, Hallstro, Manios, ´a I Mesana, De ´nes Molna ´, Dietrich, Piccinelli, Plada, Sjo ¨stro ¨, Moreno & Kersting (2011) conducted a Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study to determine the nutritional knowledge of adolescents in Europe. They found that about 60% of the questions were answered correctly (no classification was made to explain this result but perhaps it could be assumed that their knowledge was adequate as it was above the 50% mark) (Sichert-Hellert *et al* 2011). According to Sichert-Hellert *et al* (2011) this result was similar to other studies assessing the nutrition knowledge of adolescents in other European countries; a result of 40% was seen in the same study conducted in America on American adolescents (Casazza & Ciccazzo 2007; Reinehr, Kersting & Chahda 2003; Pirouznia 2001; Hodgson, Wilkerson & Go 2000).

A possible reason why the general- and sports-related nutrition knowledge of participants in the current study was found to be adequate, could be that the basic nutrition course forming part of the compulsory subject Life Orientation (Department of Health 2005), contributed to their nutrition knowledge. However, Life Orientation is taught in the intermediate phase of government schooling (grades seven to nine) in South Africa and the time allocated to nutrition is a small section of one out of five learning outcomes that must be met for this subject (DOH 2005). The latter therefore possibly accounts for the lack of in-depth nutrition knowledge displayed by study

participants. Areas where participant nutrition knowledge was inadequate, included: carbohydrates, well-balanced diets, healthy eating and protein intake and use in the body.

The following questions serve as an illustration of the above observation: (i) 53.2% of participants believed that starchy foods should not be eaten when trying to lose weight; (ii) 38.2% responded 'true' to the question that implied eating bread always causes weight gain; (iii) 30.5% of participants believed that starches should not be eaten at most meals as they cause weight gain; (iv) 45.8% of participants believed that dry beans, peas and lentils are not a healthy choice to eat instead of meat; (v) 45.9% and 43.1% of the participants suggested that chicken, fish, beans and eggs and apples, bananas, spinach and carrots, respectively, are the food groups that should make up the bulk of the daily diet. Only 9.2% of participants correctly answered that bread, samp, rice and porridge should form the basis of the diet; (vi) 38.9% and 33.3% of the participants believed that a diet should mainly consist of meat and vegetables, respectively, while 13% of knew that a diet consisting of mostly starch is a well-balanced diet.

Rodriguez (2012); Smit (2012); Burke *et al* (2011); Ferguson-Stegall *et al* (2011); Chee (2010) and Rodriguez *et al* (2009) explain why the perception of protein foods being the main source of fuel for the body not recommended for especially adolescent rugby players, as they undergo a series of aerobic and anaerobic bouts of exercise during training. Carbohydrates are the preferred source of fuel in an athlete during longer periods of intense exercise or short bouts of highly-intense exertion. Having depleted glycogen stores will negatively impact the rugby player's performance as it would result in their aerobic pathway not functioning optimally. The latter will result in fatigue and sub-optimal performance during training sessions.

When questioned about what the key to healthy eating is: (vii) one out of ten (10% of participants) selected the correct answer, namely eating "many different kinds of foods", whereas just over a half (51.8%) of the participants selected the "all of the above" option, thereby indicating that they were unsure of the correct answer. Vorster (2013) reiterates the fact responses v-vii are not considered to be a well-balanced diet as the South African Food Based Dietary Guidelines encourage South Africans

to consume starchy foods as the basis of their meals rather than having protein foods as the base. Nearly two thirds (64.2%) of participants knew that milk and yogurt are good sources of calcium but a very few, i.e. 2.8% of subjects, knew that pilchards are also a good source of calcium.

The above results are very similar to the findings by Walsh *et al* (2011), whereby questions regarding protein in the body were answered incorrectly. The aspects of protein that were incorrectly understood were: the role protein plays in providing energy, the negative effects of eating too much protein and the true effects on the body that protein has. Only 39% of Irish adolescent rugby players knew that protein is not the main source of energy for the muscles, thereby indicating a poor understanding of the function of carbohydrate in the body. However, findings by Webb & Beckford (2013) differed to the above in terms of general nutrition knowledge of adolescent athletes as findings were that there was a lack of understanding regarding both protein and carbohydrates and their role in the body. More than half the adolescent swimmers from Trinidad and Tobago had insufficient knowledge regarding carbohydrates and protein and their role in the body with 20% having a correct understanding regarding the role of protein and 46% understanding how carbohydrates are stored in the body (Webb & Beckford 2013).

Burkhart (2010) found that adolescent athletes understood that carbohydrates and protein are important sources of energy in the body but like the current study and studies conducted by Webb & Beckford (2013) and Walsh *et al* (2011), there was is poor understanding in terms of the role they play in the body. In the current study, when asked whether carbohydrate consumption was most important before, during or after exercise, 30.9% of participants answered after exercise while 63.6% answered before exercise. Dunford & Doyle (2012); Rodriguez (2012) and Hoffman (2011), suggest that the post-workout meal is vital to replenish the total energy, carbohydrates, proteins and fluids and electrolytes lost throughout the workout. If a carbohydrate-rich meal is not consumed post-exercise, macronutrient losses will result in decreased performance in the next exercise session and could also impair the athlete's health in the long run (Dunford & Doyle 2012; Rodriguez 2012; Rodriguez *et al* 2009).

According to Burkhart (2010), adolescent athletes may be influenced by the increasingly popular fad of low-carbohydrate, high-protein diets seen in the media and advertised regularly. This view is underlined by the fact that in the current study, 40-55% of the adolescent rugby player's source of nutrition information was the media, their parents and the school/ coaches. It is highly probable that many parents and coaches also obtain their nutrition information from media sources. In addition, the media tend to generalize statements regarding low-carbohydrate, high-protein diets that supposedly result in increased lean muscle mass with a lower 'fat' gain (Burkhart 2010). Strasburger, Jordan & Donnerstein (2010); Rideout (2010); Strasburger, Wilson & Jordan (2009) and Pecora, Murray & Wartella (2007) recognize that more than 50 years of research into the influential role of media on young adults has proven the connection between health and behaviour of adolescents and what they see or read on public forums of any sort. They underpin the influence media has to the fact that adolescents are spending more time using media in all its forms more than any other activity besides sleeping (more than 7 hours a day) (Rideout 2010).

One such media influence is "the Real Meal Revolution", a concept adopted by Professor Tim Noakes (a South African professor of exercise and sports science at the University of Cape Town) (Noakes, Creed, Proudfoot & Grier 2013). He developed the "high fat", "low carbohydrate" diet which coined the term the "Banting" diet, amongst others (Noakes *et al* 2013, p18). Noakes *et al* (2013, pp22-23) suggest that the diet is based on the notion that cutting out all forms of carbohydrates from the diet and instead eating large amounts of animal and plant fats as well as protein will cause the body to transition to state where weight loss and management becomes much easier and a more attainable goal. Noakes *et al* (2013, pp22-23) believe that the hormone insulin causes all carbohydrates to be turned into and consequently stored as fat in the body resulting in a person then getting fat. Noakes *et al* (2013, p22) also made several bold statements that were published in their book (The Real Meal Revolution) and on internet sites across the world; one being "fat does not make you fat. Carbs do". This sensationalist remark is one of the many contributing factors to the numerous negative and unscientific fallacies surrounding carbohydrates and one of the reasons attributed to the "fear" of carbohydrates.

The majority of these speculations are not scientifically sound and are based on non-scientific opinions. However, young, aspiring athletes tend to believe that a high-protein, low-carbohydrate diet is necessary for optimal sports performance, muscle building and strength (Burkhart 2010). Noakes *et al* (2013, pp32-33) also make provision in the diet for several "special" conditions or situations; one such "special" situation is for athletes. They state that the glucose used during exercise (normally a broken down product from the ingestion of carbohydrates) can in fact be produced by the liver in the amounts required (Noakes *et al* 2013, pp32-33). Noakes *et al* (2013, pp32-34) suggest that a diet rich in carbohydrates may be beneficial to some athletes but to many a diet low in carbohydrates and higher in protein and fat will be more beneficial. To facilitate optimal utilization of dietary protein and to ensure that it is used for its primary function in the body, a diet with an adequate energy content (carbohydrates will contribute to achieving the correct energy content) should be consumed (Rodriguez 2012; Rodriguez *et al* 2009).

5.4 Observed trends in nutritional practices of the study sample

In the current study, nearly 68.6% of the participants indicated that they made dietary changes in order to assist them in achieving their goals. The most popular changes to their diets included: healthier food choices (less junk food) (52.7%), increased protein portions (48.2%) and more fruit and vegetables (40.9%). These results are similar to that reported by Strachan (2009), namely that an increase in vegetable and fruit consumption as well as protein portions were the most prevalent dietary changes implemented. Increasing carbohydrate portions was reported by 60% of Strachan's (2009), study sample. A finding contradictory to that of the current study sample. Participants in the current study also selected the option "critical, can't live without it" regarding the following practices: exercise, gym/weight training, diet/what you eat and rest. Supplement use ranged from: "not important" (33.9%) "helps a little" (30.3%), "fairly important" (18.3%), "very important" (16.5%) and "critical, can't achieve without it" (0.9%).

Findings by Strachan (2009) were that 8% of the study participants considered supplements as being important for success. Burkhart (2010) on the other hand, found that 78.6% of the rugby players surveyed, considered sports nutrition to be very

important, while 96.4% believed that sports nutrition assists in improving overall performance. In addition, rugby was the sport that scored the second highest (after underwater hockey) in terms of importance of sports nutrition as contributing to the enhancement of performance. This finding could possibly be related to the fact that physique and body conditioning plays such an important role in position-specific performance on the field (Lambert 2009).

More than 50% (57.8%) of the participants in the current reported that they did use a nutritional supplement. This result concurs with the 54% reported by Strachan (2009) regarding current perceptions and usage of nutritional supplements amongst adolescent rugby players from Kwazulu-Natal. Furthermore, these results are in accordance with findings from the United Kingdom (UK) (62%) and the United States of America (42%) (Nieper 2005; Jonnalagadda, Rosenbloom & Skinner 2001). Countries like France and Canada reported a low prevalence of nutrition supplement use that ranged from 8% to 13.5% (Field, Austin, Camargo, Taylor, Striegel-Moore, Loud, Colditz 2005; Laure, Binsinger 2005; Bell, Dorsch, Mccreary, Hovey 2004; Mason, Giza, Clayton, Lonning; Wilkerson 2001). O'dea (2003) conducted a study on 78 male and female adolescents at a government high school in Australia to determine the use and perceived benefits of supplementation by these young adults. The study results revealed that the adolescents believed supplements would provide them with adequate energy and an "energy boost" (O'Dea 2003). What O'Dea (2003) recognized was that the adolescents were confusing the "energy boost" in the supplements with the stimulant (e.g. caffeine, guarana and ginseng) present in the supplement ingested. The author further explains that the confusion between the energy provision and the stimulant may be accredited by the media advertising these nutritional supplement products as being healthy and necessary to get through a busy day (O'Dea 2003).

Strachan (2009) suggests that levels of nutritional supplement use in South Africa are higher than other parts of the world because the bar for South African school rugby has been raised dramatically. Hence the pressure and expectations of local young athletes has resulted in them relying on supplementation use to perform at a higher level and implement advice given regarding the desired body types; best suited to their playing position. Strachan (2009) also speculates that another variable that could explain supplement use among young local rugby players, could be related to

advertising and accessibility of supplements in local supermarkets and pharmacies. van Aswegan (2013); Powers (2011) and Gradidge *et al* (2010) all conducted studies that portrayed the significant burden felt by adolescent athletes trying to grow and develop in their sporting field. They documented trends that showed that the athletes understood that supplement use was a form of cheating but continued to use them in order to cope with the stress and pressure to perform (van Aswegan 2013; Powers 2011; Gradidge *et al* 2010). Powers (2011) found an interesting result whereby most of the adolescent rugby player participants in the study did not see a problem regarding the use of supplements in order to succeed.

According to Gradidge *et al* (2010), there is a difference between nutritional supplements and performance enhancing supplements (PES) in that nutritional supplements in general are food/ nutrient based and may or may not have an effect on athletic performance and health of adolescent athletes as opposed to PES, which are non-nutritive drugs used to achieve better results in the sporting world and are often illegal (Gradidge *et al* 2010). Of the participants in the current study that indicated the use of nutritional supplements, 27% admitted to using the supplement 3-4 times a week, 22.2% admitted to using it daily, while the remainder used it once or twice a week, less than weekly or once a week. Strachan (2009) found that the majority of adolescent rugby players uses supplements two to three times per week (24%) and daily (35%). Results which are similar to the findings of the current study. In a study conducted on junior athletic athletes in the UK, findings were that the study sample used nutritional supplements on a daily basis with a mean usage of 2.4 products per day (Nieper 2005). Walsh *et al* (2011) found that 63.7% of Irish senior school rugby players used nutritional supplements, even though they knew that these supplements may not provide the results that advertisements promised. Webb & Beckford (2013) investigated the use of vitamin and mineral supplements by young athletes and found that only 10.5% of the study sample knew that the use of vitamin and mineral supplements are not obligatory for young athletes.

Of the participants in the current study who indicated that that they were using a nutritional supplement, 38.2% reported that protein shakes were their first choice of supplementation. This was followed by energy drinks (19.1%), meal replacements (10.9%) and mass builders (9.1%). Creatine was used by 8.2% of participants. Results

reported by Strachan (2009), found protein (43%) and creatine (22%) to be the most popular supplement choices. Walsh *et al* (2011) who found that 43.8% of the participants who used a nutritional supplement used protein, while 28.6% used creatine. Perhaps the cost of creatine supplementation is what leads to the lower than average use of this usually popular supplement by the participants in the current study. Strachan (2009) explains that many participants misunderstood the true role of creatine in the body. Hence it could be speculated by the primary investigator that the reasoning behind the majority of supplements used by young athletes, are not fully understood. Unfortunately sophisticated marketing techniques easy access to nutritional supplements has resulted in young aspiring athletes to be influenced very easily. In addition, they are not well informed in this regard and often look up to famous professional sportsmen who endorse these product hence enticing them into using these products (Strachan 2009 & Rosenfield 2005). Results of the study conducted by Nieper (2005), advocate that the professed physiological benefits of nutrient supplements, sports and energy drinks may be the driving force behind their use by adolescent athletes, regardless of their potential risks.

In the current study, 63.5% of participants responded that they will consider using a non-nutritional supplement to aid their sports performance and achieve their goals. This finding could possibly be attributed to the way in which the question was worded in having deliberately avoided the use of the word ‘illegal’. Thus perhaps positively provoking a more honest answer. The percentage reported in the current study could possibly be related to the pressures experienced by young athletes to achieve and perform optimally (Strachan 2009). A similar question but worded from a different angle, also formed part of the survey questionnaire, i.e. the current use of a nutritional supplement with negative side-effects that participants may be unaware of; 90.7% responded no. This finding could be related to the fact that subjects might not be using a supplement of this nature. However, it is also possible that they could consider using such a supplement in future. Especially considering given the percentage of participants in the current study were junior players (mean age 15 years). It is also possible that participants were not truthful in their response to this question.

Regarding the use of a pre-workout supplement, 80% of participants reported that they are currently not using one. Gradidge *et al* (2010) found that 30% of male

Johannesburg-based adolescent athletes were using a performance enhancing supplement and that the main reason for its use was the held belief that it helps to improve sporting performance. Gradidge *et al* (2010) again highlight the fact that this could be attributed to the pressure these young athletes are subject to in achieving top results, irrespective of the financial and physical cost.

5.5 Characteristics of study sample regarding the forward and backline players.

The mean age for the forwards (n=63) and backline (n=47) participants was 15 years old while 81% of the forwards and 76.1% of the backs were white. Nearly two thirds (63.5%) and 74.5% of the forwards and backline participants, respectively, were school boarders. The forwards include the following player positions; flank, lock, prop, hooker and loose forward and the backs included the wing, scrumhalf, inside centre, fullback, flyhalf, outside centre and eight man.

5.6 Observed trends in the general- and sports-related nutrition knowledge of the study sample when comparing forwards and backline players

Both forwards and backline players had an adequate general- and sports-related nutrition knowledge. However knowledge was lacking in the areas such as carbohydrates, balanced diets, healthy eating and protein intake and use in the body. The only statistically significant difference between the forwards and backline players were for the following questions: “the reason why dry beans, peas and lentils are good” ($p=0.011$) and “the importance of hydration” ($p=0.012$). These findings compare favourably with that of Walsh *et al* (2011) who found no significant differences in the nutrition knowledge of adolescent rugby players in terms of player position.

More than half of the backline players (57.4%) believed that starchy foods should not be eaten when trying to lose weight. However although not statistically different, 50.8% of the forwards disagreed with this statement, the remainder believed the opposite. A possible reason for the above findings could related to the findings of Lambert (2009) and Duthie, Pyne & Hooper (2003) who noted that the stature and body mass of the forwards and backline players should differ due to their different, respective duties that need to be performed on the field. The forwards tend to have a higher body mass and

body fat percentage than the backline players as forwards undergo rucks, mauls and scrums that require strength and power. Backline players on the other hand require more speed and agility rather than strength and power thus more stringent management is required by the backline players (Lambert 2009; Duthie *et al* 2003). As a result the backline players could have developed a greater awareness of carbohydrate/starchy foods as their weight control is so easily influenced by their diet and with the numerous fallacies regarding weight-loss and carbohydrates punted in the media. The media and public figures can be very persuasive and are not always accurate in their statements, again the banting diet developed by Professor Tim Noakes can be seen as one of these unscientifically sound media frenzies that play such an influential role.

A similar trend was found regarding dietary changes pre and post-season. More than 51.6% of the forwards admitted that their diets do change over the playing season, while 44.7% of the backline players acknowledged that their diets over the playing season. However, these differences were not statistically different.

5.7 Observed trends in nutritional practices of the study sample when comparing forwards to backline players

A statistically significant difference (p=0.011) between forwards and backline players became evident regarding the use of amino acids as a supplement and when players were asked whether they are using a supplement to enhance their performance that may have negative side effects that they are unsure of. Just over eight out of ten (85.2%) of the forwards and 97.8% of the backs responded no (p=0.012). More than half of the forwards (58.7%) and backs (56.5%) reported to be taking dietary supplements. Walsh *et al* (2011)'s study on the nutritional knowledge and dietary and hydration practices amongst other things, found that 68.7% of the forwards admitted to taking dietary supplements as opposed to 51% of the backline players. However, these results did not differ statistically significantly.

This could, again, be related to the need of forwards to have a higher BMI, percentage muscle mass and body fat percentage in order to obtain the competitive edge over their opponents in scrums, rucks and mauls (Lambert 2009; Duthie *et al* 2003). According to result generated by Walsh *et al* (2011) 46.8% of the players either agreed

or strongly agreed that supplements are necessary to support their training programme. In addition, of those players who reported taking dietary supplements, 63.8% believed that their use is necessary to support training performance.

Of the forwards and backline players, 66.7% and 71.1% respectively, made changes to their diet. The three most popular changes for both the forwards and backs were: making healthier food choices (less junk food) and increasing protein, vegetable and fruit intake. However, a difference in trend between the forwards and backline players were regarding how important they perceived gym/weight training to be in achieving overall success. The forwards considered it to be very important, while the backs considered it to be fairly important. Physiologically forwards and the backs will differ in size, body, weight and muscular composition and strength due to the nature of their positions on the field (Lambert 2009; Duthie *et al* 2003). Forwards need to be larger in all of the above three components. This could possibly explain the difference in level of importance forwards versus backs rated gym and weight training (Lambert 2009; Duthie *et al* Hooper 2003). Both the forwards and the backs considered exercise/practice sessions, diet and rest critical to their achievements, while taking supplements were rated as “not important” to their performance. No other differences were observed in the trends of forwards versus backline players in terms of nutritional practices.

5.8 Characteristics of study sample regarding the players of each age group

For the purposes of the current study, the data of the first, second, third and fourth teams were pooled to create the open age group. The age group sample characteristics did not differ significantly from the sample characteristics seen in section 5.2 regarding the overall study sample characteristics. The mean age for the under 14’s was 14 years, while it was 14.5 years for the under 15’s and 15 years for the under 16’s. The mean age for the open age group was 17 years. More than 70% of all the age groups were white, while more than 60% of all the age groups resided in the school’s boarding establishment. The only coloured and Indian participants played in the under 15 age group. These results are to be expected, as they follow a similar trend to that which was reported for the overall study sample discussed in section 5.2 above.

5.9 Observed trends in the general- and sports-related nutrition knowledge of the study sample in terms of player age groups

After assessing the knowledge of the under 14 age group across age groups up to the open age category, statistically significantly results were obtained for the following categorical variables in relation to age group: “You should eat a lot of sugar to have enough energy” (p=0.034); “You should add extra salt to your cooked food before you eat it” (p=0.007); “Sugar contains a lot of vitamins and minerals” (p=0.045); “Being physically active means” (p=0.002) and “How much milk or maas should consumed per day” (p=0.021). Walsh *et al* (2011) reported a similar trend in their results when comparing the nutrition knowledge of the Irish adolescent rugby players aged 16-18 (no indication was made by Walsh *et al* (2011) in the results or discussion chapters as to how these results were obtained).

Due to the satisfactory general- and sports-related nutrition knowledge scores (under 14’s: 63.3%, under 15’s: 65.8%, under 16’s: 64.0% and open age group: 67.7%) achieved by all four age groups, it can be deduced that each age group had an adequate general- and sports-related nutrition knowledge. Where the combined score of the individual players from each age group amounted to less than the overall mean score obtained (less than 50% of the questions answered correctly) it could be deduced that their nutrition knowledge was not adequate, especially in terms of carbohydrates, what a well-balanced diet entails as well as healthy eating and protein intake and use in the body. The under 14, 15, 16 and open age group all had a similar mean score regarding general- and sports-related nutrition knowledge with noticeable differences regarding starch consumption. The under 14, under 16 and open age groups all believed that starchy foods should not be eaten when attempting weight loss. The under 15’s were the only age group to answer this question correctly; although only 52.2% of them did so. There was no clear explanation as to why the under 15 age group were the only ones to answer this question correctly, however, the result was not statistically significant and therefore requires further investigation amongst a larger sample size.

While more than 60% of the under 14, under 15 and under 16 age groups responded 'false' to the question whether 'eating bread always causes weight gain', the open age group were evenly divided in their responses regarding this question (50%). It would seem that there is a lack of published studies investigating this perception amongst consumers. However, this finding was not statistically significant across age categories. It could therefore be speculated that possibly the 'fear' of carbohydrate consumption in conjunction with weight loss or weight gain may be spurred by the media and fad diets (Burkhart 2010). Many non-rugby related studies that were conducted by Burkhart (2010); Montfort-Steiger & Williams (2007) and Petrie *et al* (2004) found that perhaps the controversy surrounding carbohydrate intake fads may be attributed to the media using results suggesting that children and adolescents use less carbohydrates and more fat during exercise. Chee (2013) however, discredits this finding for rugby players as it is recognized that a rugby player's primary source of energy should be derived from carbohydrates as training on depleted glycogen stores will cause the aerobic pathway not to function at its maximum capacity. The latter in turn, will result in sub-optimal training sessions and could possibly lead to injuries (Chee 2013; Smit 2012).

5.10 Observed trends in nutritional practices of the study sample in terms of player age groups

The only statistically significant finding regarding nutritional practices between the age groups, was for the use of amino acid supplement (21.4% of the open age group reported using amino acids as their most frequently used supplement while none of the other age groups reported to be using amino acids). Webb & Beckford (2013); Walsh *et al* (2011); Burkhart (2010) and Gradidge, Coopoo & Constantinou (2010) did not find any results relating to amino acid supplementation use in the adolescent athletes involved in their studies and Molinero & Márquez (2009) acknowledge that amino acid supplementation has no proven benefits.

The under 14 age group were the only age group that reported that their diets were supplemented with nutritional supplements. However, this finding was not statistically significant. In addition, there were no published studies that could verify these results that were unexpected, seeing that the under 14 age group is still very young and

therefore might not fully comprehend the role that supplements can play in their diet and performance. These results are also contradictory to the reworded question regarding supplement use where only the under 15, under 16 and open age group indicated that they were using a nutritional supplement. The open age group were the only players who indicated that their diet changes between seasons. This finding could be related to these players having a better understanding of weight maintenance in accordance with playing position. In order to meet the position requirements during the rugby season and relax in the off-season, dietary manipulation would therefore would be called for. (Chee 2013).

Another difference in the observed trends amongst age groups, was the source of nutrition information. More than 50% of the under 14, under 15 and under 16 age groups indicated 'parents' as their primary source of information whilst the majority of players in the open age category, obtain their information from the media. This result could be justified by Weichselbaum & Buttriss (2014) who suggest that with the further transition into adolescence, a sense of independence and individuality is explored by young adult by perhaps not weighting their parents opinions as highly as what they used to. Burkhart (2010) also realizes that parents of adolescents may be obtaining their nutritional information from the highly influential media. This in turn will mean the information they relay onto their children will have been subjective to what they may have heard and thus will not be the nutritionally sound advice these young, aspiring adult athletes need (Burkhart 2010).

When questioned on the importance of gym/weight training to enhance performance the under 14 and under 15 age group felt it was fairly important in order to achieve their goals. The under 16 and open age group differed in their response as it was felt that gym and weight training was very important to their overall performance. Despite a lack of published literature to explain this finding, it is possible that this result could be attributed to the fact that as the level of rugby competition increases, so too does the need to attain a physiological and fitness competitive edge. Lambert (2009) and Duthie *et al* (2003) explain that the size and mass of a rugby player increases along with the development of the game, competence and skill.

The last differential amongst age groups, highlight the perceived importance of supplements in achieving performance goals, as the under 15 and 16 age groups were of the opinion that supplements were not of any importance in reaching their goals, while the under 14 age group indicated that it may help a little. The open age group stated that supplements were very important to achieving overall success. Unfortunately there seems to be a paucity of published data but could possibly be attributed to a number of factors. The belief of the under 14 age group that supplements are of slight importance may stem the fact that they look towards senior players as role models or from what is being portrayed by the media as 31.6% of under 14's admitted that the media was a source of their nutrition information.

It is also possible that younger players are more easily swayed by external influences when it comes to shaping their ideas. However, the fact that under 14's and players in the open age group were better presented in the study sample than under 15's or under 16 players, might also have influenced the study findings. The held belief by players in the open age group that supplements are very important to their overall success, may stem from the pressure faced by players in this category to be accepted into tournaments like Craven Week or University Cup. Strachan (2009)'s study found existing results that suggest a concurrent link between substance abuse and the pressure to perform in the sporting activity. Gradidge *et al* (2010) are also of the opinion that young South African athletes deem it necessary to use nutritional supplements and even illegal performance enhancing substances to remain at competition level.

This finding is echoed by results from the current study whereby not only players in the open age group but more than 50% of the remaining age groups indicated that they would consider using a non-food supplement that may help them achieve their sporting goals. The fact that players in the under 14 age group admitted to considering the use of non-food (non-nutritional) supplements to help them achieve their sporting goals is source for concern. The above could be indicative of a ripple effect whereby incorrect held beliefs are viewed as being vital to success by the older age groups as a result of pressure to perform and attain the competitive edge. These beliefs in turn could possibly influence the perceptions and beliefs of younger players before the pressure to perform at a certain level has been set in motion.

5.11 Characteristics of study sample comparing the open age group and non-open age category

For the purposes of the current study, the data of the first, second, third and fourth teams were pooled to create the open age group. For the purposes of this section of results in the study the under 14, under 15 and under 16 age groups were pooled together to create the non-open age category in order for their trends to be comparable to the open age group. The open age group and non-open age category sample characteristics did not differ significantly from the sample characteristics seen in section 5.2 regarding the overall study sample characteristics. The mean age for the open age group was 17 years whilst the mean age for the non-open age category was 15 years. More than 70% of all the age groups were white and the Indian and coloured participants were representing the non-open age category. More than 60% of all the age groups resided in the school's boarding establishment. The mean ages were statistically significantly different (p=0.000) which is explained as the open age group are generally represented by the 'senior' boys at the school (from 16 years and older) whilst the non-open age category are generally represented by the 'junior' boys at the school (from 13-16 years old). There may be a couple exceptions to this rule of thumb if a 'junior' player is good enough to play in the 'senior' teams. These results are to be expected, as they follow a similar trend to that which was reported for the overall study sample discussed in section 5.2 above.

5.12 Observed trends in the general- and sports-related nutrition knowledge of the study sample when comparing the open age group and non-open age category

After assessing the knowledge of the open age group and non-open age category, statistically significantly results were obtained for the following categorical variables in relation to age group: "You should eat a lot of sugar to have enough energy" (p=0.019); "Sugar contains a lot of vitamins and minerals" (p=0.007); "There is a difference between good and bad fats in food" (p=0.041); "My diet changes between pre, during and post season" (p=0.051); choosing the correct response to why starches should not be eaten at most meals (p=0.051); determining what a low fat snack is (p=0.042);

deciding how much milk, maas or yogurt should be consumed per day (p=0.032) and finally the understanding of which energy drinks contain caffeine (p=0.048).

Through the observation of the results comparing the general- and sports-related nutrition knowledge of the open age group (95% for section A and 62.5% for section B) and non-open age category (95% for section A and 67.8% for section B) it can be concluded that both age categories have an adequate general- and sports-related nutrition knowledge. Areas from which both age categories scored less than 50% thus representing an inadequate knowledge were: carbohydrates, what a well-balanced diet entails as well as healthy eating and protein intake and use in the body. Walsh *et al* (2011) found a similar trend in their results when comparing the nutrition knowledge of the Irish adolescent rugby players aged 16-18 (no indication was made by Walsh *et al* (2011) in the results or discussion chapters as to how these results were obtained). They found no statistically significant difference between the knowledge scores of the different age groups and no statistically significant improvement in the knowledge either (Walsh *et al* 2011).

Results obtained by Webb & Beckford (2013) differed somewhat as they found that the higher the age category the better the nutrition knowledge was. They also found a statistically significant result whereby the attitude towards nutrition increased as the age range did (Webb & Beckford 2013). A similar result to Webb & Beckford (2013) was seen with male and female sports department, university level students in Ankara by Ozdoğan & Ozcelik (2011) who found the fourth year students to have a statistically significantly higher nutrition knowledge score to that of the first year students. Burkhart (2010) published no trend between the senior and junior athletes. It would be assumed that the general- and sports-related nutrition knowledge of the open age group adolescent rugby players in the current study would be higher than that of the non-open age category. This was not the case, in fact it was slightly lower in some instances. This may be attributed to the lack of sound and in-depth nutrition education received by these boys at the school. Although their nutrition knowledge was adequate they fell short in areas of primary concern, as mentioned earlier. This can also be accredited to the numerous discrepancies found in the nutrition information portrayed and relayed to the public by the media forums.

Most of the answers to the true and false and multiple choice section of the general- and sports-related nutrition knowledge questionnaire by the open age group and non-open age categories trend in a similar way. Both the open age group (57.1%) and non-open age category (51.9%) believe that starchy foods should not be eaten when trying to lose weight. But the open age group was split evenly (50%) between their belief as to whether eating bread always causes weight gain whereas only 34.1% of the non-age category believed that eating bread always causes weight gain. Again, it could be speculated that possibly the 'fear' of carbohydrate consumption in conjunction with weight loss or weight gain may be spurred by the media and fad diets (Burkhart 2010). Many non-rugby related studies that were conducted by Burkhart (2010); Montfort-Steiger & Williams (2007) and Petrie *et al* (2004) found that perhaps the controversy surrounding carbohydrate intake fads may be attributed to the media.

The "low carbohydrate", "high fat" diet developed by Noakes *et al* (2013) is one such media fad that has taken the country by storm and could definitely influence the minds of young adults. The open age group also differ in their response to on much milk, maas or yogurt should be consumed daily in that 67.9% of them incorrectly believe only one cup should be consumed daily whereas 44.4% of the non-open age category correctly believe that two cups should be consumed daily. This leads to the question as to the depth of the nutrition knowledge of the open age groups. They understand that these dairy products are necessary in the diet but are unsure of how much is needed. A statistically significantly larger 21.4% of the open age group in comparison to 14.6% of the non-open age category believe that caffeinated beverages are necessary to provide energy before a practice or game. Seifert, Schaechter, Hershorin, Lipshultz (2011); Lee (2011); McCarthy (2011); Nitzke, Tanumihardjo, Salomon & Coleman (2011); Odd & O'Sullivan (2009) and Reissig, Strain & Griffiths (2009) recognize that energy drinks (a beverage that contains caffeine, taurine, vitamins, herbal supplements, and sugar or sweeteners) make up the fastest and largest growing beverage market in the United States.

They also found that adolescents (12-18 years old) made up 1 of three age categories that contributed to half of the total energy drink sales. Seifert *et al* (2011); Simon & Mosher (2011) and Hein (2011) suggest that one of the reasons for the increase in popularity of energy drinks may have something to do with the way they are marketed.

The marketing techniques used include sponsoring sporting events, sponsoring famous athletes and using social media such as Facebook and Twitter (increasing the popularity and 'cool' status of these products) (Seifert *et al* 2011; Simon & Mosher 2011; Hein 2011). The cans in which these energy drinks are sold are also appealing to the eye and catch the attention of these young adults over and above the clever marketing ploys (Seifert *et al* 2011; Simon & Mosher 2011; Hein 2011).

5.13 Observed trends in nutritional practices of the study sample when comparing the open age group and non-open age category

Several statistically significant differences between the open age group and non-open age category were seen in the results. The non-open age category relies on school as the source of nutrition information statistically significantly less than the open age group (p=0.043). Although not statistically significantly different; media was selected as the most popular source of nutrition information for the open age group (53.6%), this differed to the open age category of which parents and school were selected as the most popular. This may be attributed to the social development of these adolescents to a state of independence from authoritative bodies and rules such as school and their parents (Weichselbaum & Buttriss 2014).

A statistically significantly higher 78.6% of the open age group as opposed to 50.6% of the non-open age category said that they use of nutritional supplements (p=0.010) but the results show that more than half of each age group use these supplements. The open age group also statistically significantly differ to the non-open age category with regards to how they believe supplements to be very important as opposed to not important at all to their overall performance (p=0.004). Amino acids as a supplement were selected as being used statistically significantly higher by the open age group than the non-open age category (p=0.000) (none of the non-open age category suggested that they use this form of supplement). This particular supplement use by the more senior rugby players may be accredited to the fact they know more about supplementation than the junior players and they may have better access to supplements in general. A statistically significantly (p=0.045) lower number of the open age group selected "no" when asked if they use a pre-workout supplement as

opposed to the non-open age category. Thus a higher number of the open age group use pre- workout supplements.

Another statistically significant difference was seen in the importance of gym/weight training to the overall performance of the open age group and non-open age category (p=0.052). 57.1% of the open age group as opposed to 31.3% of the non-open age group believe gym to be very important to their overall performance. The results also show that the open age group use the supplements most often with 40.9% of them using their supplements 3-4 times a week and 27.3% using their supplements on a daily basis (as opposed to once or twice a week being the most popular for the other age category). 17.9% of the open age group said that they use creatine (as opposed to less than 10% for the other three age groups). 75% of the open age group selected that they would in fact consider the use of a non-food supplement if it would help the achieve their goals, with 59.2% of the non-open age category suggesting that they would consider the use of these supplements. These results, whether they are statistically significant or not, may be attributed to the result of the increased pressure the more senior rugby players will feel to perform (Strachan 2009).

Anon (2014b) and Strachan (2009) highlight the immense struggle a young male rugby player will have to endure as they get older (move from the junior to the more senior teams) to be selected to play in events or clubs that will bridge the gap to a professional career in this sport. Unfortunately, Gradidge *et al* (2010) and Molinero & Márquez (2009) recognize that in order to account for this immense pressure to succeed as the athletes get older they turn to supplement use and abuse. They also believe that marketing and the media have played a very significant role in the increased use of these supplements as well as their perceived ‘importance’ and ‘necessity’ (Gradidge *et al* 2010; Molinero & Márquez 2009).

A large percentage of the open age group (85.2%) as opposed to 62.8% of the non-open age category suggested that they have made changes to their dietary habits to help achieve their goals. With 71.4% of the open age group selecting the change of increasing the protein portions in their diet (as opposed to 40.2% for the non-open age category). This fixation with protein that adolescent athletes have may have stemmed from the incorrect assumption that large amounts of protein are needed in order to

gain and promote muscular growth. Several factors can be credit as the reason for the protein ‘craze’. One such promoter of the protein frenzy in the media is the ‘banting’ diet spoken about earlier in the chapter that was developed by Tim Noakes (Noakes *et al* 2013, pp18-34). Other alarming resources of this misinformation regarding protein are freely available on the internet. One such resource is the BokSmart practical nutrition guide for rugby players whereby Meltzer & Fuller (2009) suggest that protein intake should be increased in order contribute to muscular gains. They incorrectly recommend that rugby players (no regard for age was made in this case) should eat 4 grams of protein per kilogram body weight per day.

Another such resource was developed by Chee (2013) who also incorrectly suggests that rugby players (again no regard for age was made here) should be consuming 3 grams of protein per kilogram of body weight per day. According to Potgieter (2013) the International Olympic Committee state that the body cannot utilize more than 1.8 grams per kilogram body weight per day. This is seconded by Rodriguez *et al* (2009) who suggest the total daily protein intake for an adult athlete (this would result in a reduced requirement when calculating in perspective of the adolescent) should be 1.2-1.7 grams per kilogram body weight per day. They further suggest that this can be met through diet alone and additional protein supplementation should not be necessary (Rodriguez *et al* 2009). Martin & Govender (2011) recognize that mass media plays a significant role in the obsession of adolescent males to conform to the ‘standards’ of the ‘ideal’ body image portrayed by media pictures and well known athletes or celebrities. The authors found statistically significant results between what the body thought of their body and their desire to be muscular as well as to what they believed to be anticipated by adolescent girls (Martin & Govender 2011).

They further distinguish how rugby, in particular, is a form of sporting activity that provides the necessary platform to contribute to this idea of the necessity for perverse muscular body image (Martin & Govender 2011). Ratele, Fouten, Shefer, Strebel, Shabalala & Buikema (2007, pp112-127) found that adolescent male rugby players tend to aspire to the image of being considered a “jock” by their fellow school mates in order to obtain and receive respect from other boys. Martin & Govender (2011) revealed in their study that South African school boys consider their size and body image crucial to their self-confidence.

5.14 Trends related to the progression of general- and sports-related nutrition knowledge in terms of player age groups

A slight improvement in knowledge (5%) was seen from the under 14 age group to the open age group. However, this finding was not statistically significant. This result compares favourably to that of Webb & Beckford (2013) and Walsh *et al* (2011) as the latter found no difference in nutritional knowledge from ages 16 to 18 years while the former found an improvement in nutrition knowledge score that correlated with an increase in age, despite not being statistically significant. Hendrie, Coveney & Cox (2008); Dunn, Turner & Denny (2007) and Jacobson, Sobonya & Ransone (2001) found that adults and college students in Europe do not have a better nutrition knowledge than that of adolescents; it does not improve at all. In addition to their results obtained, Webb & Beckford (2013) also found a correlation between age and the attitude of the adolescent athletes towards nutrition whereby the older the adolescent athlete got the more interested they became in learning about and practicing sound nutrition.

5.15 Summary

The average age of the study sample (N=110) was 15 years. The minimum age being 13 and the maximum age being 19, consistent with the period of adolescence. The majority of the study sample were borders and the under 15 age group showed the highest participation rate. The racial breakdown was skewed in favour of the white population with only one representative from the Indian and coloured populations. These results correlated to the racial breakdown of the 500 rugby players at the urban secondary school involved in the study. This chapter discussed the results found through the investigation of the general- and sports-related nutrition knowledge of adolescent rugby players at an urban, secondary, government school in PMB; the comparison of the general- and sports-related nutrition knowledge of the forward and backline players, each age group (under 14, under 15, under 16 and open), the open age group in relation to the non-open age category and finally the progression of the general- and sports-related nutrition knowledge from the under 14 to open age group.

The results showed that the adolescent rugby players at this urban, secondary, government school in PMB had an adequate general- and sports-related nutrition knowledge. This same result was found when comparing the forward and backline players, each age group, and the open age group to the non-open age category. The results also showed that the participants (in each comparison) lacked knowledge in the areas including: carbohydrates, well-balanced diets and healthy eating and protein intake and use in the body. The lack of knowledge in these areas could be attributed to numerous things as spoken about in this chapter; one being the paucity of accurate data regarding carbohydrates, balanced diets and protein in the media and other easily accessible resources.

Numerous statistically significant results were seen for the general- and sports-related nutrition knowledge of the participants and each comparative variation. Most of them were found when comparing the general- and sports-related nutrition knowledge and trends of the open age group and the non-open age category. However, the results showed no statistically significant result when observing whether there was a progression of knowledge from under 14 to open age groups. This indicated that perhaps the open age group differed from the other three age groups in areas regarding their nutrition practices (such as supplement usage) and their attitude towards their diets in relation to their performance rather than in the nutrition knowledge per say.

In Chapter 6 that follows the conclusions, limitations and strengths of the study will be discussed as well as the recommendations for nutrition practice and future research.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Webb & Beckford (2013) and Burkhart (2010) recognize the lack of published data on the general- and sports-related nutrition knowledge of adolescent athletes. As a result, the aim of this study was to determine the general- and sports-related nutrition knowledge of male adolescent rugby players attending a boy's urban secondary government school in Pietermaritzburg (PMB), KwaZulu-Natal. This study also documented the use of nutritional and non-nutritional supplements by the study sample as well as their source of nutrition information and supplement use.

6.2 Conclusion

Adolescence is a period of physiological, psychological, social and emotional changes (Burkhart 2010; Stang, Taft Bayerl & Flatt 2006; Hoelscher, Evans, Parcel & Kelder 2002). Coupled to the above, these young adults are prone to undergoing changes in their dietary habits that is prompted by their desire for independence and individuality (Burkhart 2010; Sigman-Grant 2002). These dietary changes often lead to an insufficient energy and/or nutrient intake. This becomes even more problematic in an adolescent athlete who not only requires additional energy and nutrients to sustain growth, but requires additional nutrition to sustain an increased level of activity (Webb & Beckford 2013). One method of ensuring that these higher energy needs are met, is through sound nutritional knowledge. Not only will this help improve overall sporting performance, but will also contribute to sustaining health and optimal growth (Walsh *et al* 2011).

As rugby is becoming an increasingly popular sport with participation commencing at primary school level, adolescents make up 29% of the registered male rugby players in South Africa (Anon 2014a). Many adolescent rugby players are participating in this high-contact, physical sport in the hope of eventually playing at provincial or national level (Anon 2014b). It therefore stands to reason, that young players should be introduced to sound general- and sports-related nutrition knowledge at an early age. Unfortunately studies have revealed that the nutritional knowledge of young athletes

is not optimal (Webb & Beckford 2013; Torres-McGehee *et al* 2012; Burkhart 2010; Rosenbloom, Jonnalagardadda & Skinner 2002). In South Africa there are no published studies that have investigated the nutrition knowledge of adolescent rugby players.

This cross-sectional study aimed to determine what the general- and sports-related nutrition knowledge of adolescent rugby players are. Hence, a self-administered questionnaire assessing the general- and sports-related nutrition knowledge of male, adolescent rugby players was completed by 110 participants that are scholars at an urban, secondary government school in PMB, South Africa. The questionnaire incorporated nutrition knowledge questions developed by Whati (2005) which were aimed at urban South African adolescents. The inclusion of sports-related questions were based on a questionnaire developed by Strachan (2009). All question included, were further justified by reference to the current literature.

Results generated by the current study indicated that participants had an adequate general- and sports-related nutrition knowledge but lacked knowledge regarding carbohydrates and protein consumption for optimal sports performance as well as understanding what a balanced diet and healthy eating are. It was indicated that parents and the media were the two major sources of this nutrition information. More than half the participants indicated that they use a nutritional supplement, while 60% of the participants admitted that they would consider using a non-food supplement to help achieve their rugby goals. These results are consistent with many studies conducted regarding supplement use by adolescent athletes in South African schools (Gradidge *et al* 2010; Strachan 2009; Molinero & Márquez 2009; Maughan 2005)

When comparing forwards to backline players, findings were that both playing positions had an adequate general- and sports-related nutrition knowledge and that there was no statistically significant difference between the nutrition knowledge of the two playing positions. This lead to the acceptance of the null hypothesis “There will be no difference in the general- and sports-related nutrition knowledge between the forward and backline players”. In addition, they also had an adequate general- and sports-related nutrition knowledge but lacked knowledge regarding carbohydrate and protein consumption as well as balanced eating and healthy eating habits. Some of

the results were consistent with the trends seen in other studies and in the literature concerning the differences between forwards and backline players (Walsh *et al* 2011). Namely, backline players are more concerned with weight management and carbohydrate consumption than forwards. In addition, forwards regard body size and gym/weight training to be a very important component of overall success.

The general- and sports-related nutrition knowledge of the under 14, 15, 16 and open age groups were also assessed. Findings were similar to what was documented for participants as a whole namely that each age group had an adequate general- and sports-related nutrition knowledge but lacked knowledge regarding carbohydrate, protein, well-balanced diets and what healthy eating entails. In addition, there was no statistically significant difference in knowledge between each age group. Walsh *et al* (2011) reported a similar trend in their results when comparing the nutrition knowledge of the Irish adolescent rugby players aged 16-18 (no indication was made by Walsh *et al* (2011) in the results or discussion chapters as to how these results were obtained). There was a statistically significant difference in the amino acid supplementation use between the age groups. The open age group was the only age group to admit to using this as a supplement. Whilst very few studies were available for comparison of the nutrition knowledge between age groups, numerous studies were used as a justification for the trends in the results found.

The results depicted that there was no statistically significantly difference in the general- and sports-related nutrition knowledge of the open age group in comparison to the non-open age category. Both age categories have an adequate general- and sports-related nutrition knowledge resulting in the acceptance if the null hypothesis “There will be no difference in the general- and sports-related nutrition knowledge between the players the open age group and the non-open age category”. Areas from which both age categories scored less than 50% thus representing an inadequate knowledge were: carbohydrates, what a well-balanced diet entails as well as healthy eating and protein intake and use in the body. The open age group relied on school as a source of nutrition information statistically significantly less than the non-open age category and a statistically significantly higher number of the open age group admitted to using a nutritional supplement. Another statistically significant difference was seen in the importance of gym/weight training to the overall performance of the

open age group and non-open age category. The open age group consider gym/weight training to be statistically significantly more important to their overall performance than the non-open age category. Finally the results regarding the open age group and non-open age category depicted that the open age group consider supplements to be statistically significantly more important to their overall performance than the non-open age category. No studies were found that compared these two groups together specifically but numerous authors were used to justify the findings with trends seen in the period of adolescence and adolescent athletes.

There was no statistically significant difference in the progression of knowledge from the under 14 age group to the open age group. This result lead to the acceptance of the null hypothesis, namely that there will be no progression in the general- and sports-related nutrition knowledge of male adolescent rugby players from the under 14 age group to open age group. The above result compares favourably to that of Webb & Beckford (2013) and Walsh *et al* (2011). Regardless of the fact that the general and sports-related nutrition knowledge of the male adolescent rugby players at this urban, secondary government school was acceptable, the lack of progression of nutrition knowledge with age, possibly signifies that the nutrition education they receive is not adequate and that more targeted nutrition education should be given to all age groups. Hendrie *et al* (2008); Dunn *et al* (2007) and Jacobson *et al* (2001) found that adults and college students in Europe do not have a better nutrition knowledge than that of adolescents; it does not improve at all.

The results of this study are similar to published studies regarding nutrition knowledge of adolescents and adolescent athletes; namely that they have an adequate nutrition knowledge but lack knowledge in area's regarding carbohydrates, the importance and role of protein and understanding of what a well-balanced diet a healthy eating entails (Walsh *et al* 2011; Sichert-Hellert, Beghin, De Henauw, Grammatikaki, Hallstro, Manios, ´a I Mesana, De ´nes Molna ´, Dietrich, Piccinelli, Plada, Sjo ¨stro ¨, Moreno & Kersting 2011; Burkhart 2010). Webb & Beckford (2013); Rodriguez (2012) and Ozdoğan & Ozcelik (2011) found contrary results indicating that the nutrition knowledge of the adolescents and adolescent athletes was not adequate but the results compared when they found that these adolescents and adolescent athlete's lacked knowledge in the same areas of carbohydrates, the importance and role of

protein in the body and the understanding of what a well-balanced diet and healthy eating entails. Due to the lack of locally published research regarding the nutrition knowledge of adolescent rugby players and the seeming need for nutrition education, results of this study underscores the importance of determining the general- and sports-related nutrition knowledge of adolescent rugby players to plan and implement targeted nutrition education.

6.3 Recommendations to improve the general- and sports-related nutrition knowledge of adolescent rugby players attending an urban, secondary schools

Changing the school curriculum to improve the nutrition knowledge would be a long term goal. However, it may prove to be beneficial to introduce general and sport-related nutritional courses as a part of the sports training schedule starting at a primary school level. In addition, dieticians could be outsourced to educate scholars or to conduct training programmes targeting coaching as they are known to have a great impact on the knowledge and practices of scholars (Ralph 2012; Kunkel *et al* 2001). It is evident that nutrition is an integral part of sporting achievement (Rodriguez *et al* 2009), attention to this aspect could enhance sports performance. As the findings of the current study did not provide evidence for a progression of nutrition knowledge across age groups, it is suggested that nutrition education should commence from under 14 age group or younger, and continue throughout the years spent at secondary school. Evidence pointing toward the use of nutritional supplements and ergogenic aids, implies that sound nutrition knowledge could lead to a better understanding of nutrition and optimal sports performance and could possibly reduce the use supplements and ergogenic aids that could prove to be harmful to human health.

6.4 Strengths of the study

The questionnaire was designed based on the validated questionnaire developed by Whati (2005) targeting urban South African adolescents and sports-related nutrition questions to determine current perceptions and usage of nutritional supplements by adolescent rugby players in Kwazulu-Natal. In addition, all the questions used in the questionnaire for the current study, were adapted and justified in accordance with the latest relevant literature regarding the topic under investigation.

6.5 Limitations of the study

The sample size (n=110) was small in relation to the total number of rugby players at the secondary urban government school surveyed (N=500), thereby reducing the statistical power of the study. The current study sample was also half the number of participants surveyed by Webb & Beckford (2013); Walsh *et al* (2011) and Strachan (2009). The sample used in this study was conveniently selected as opposed to being randomly selected thus leading to the possibility of selection bias and compromising the inferences of these results on the general population.

Rugby players of one boys only government school in PMB, was surveyed. This implies that the results of the current study cannot be extrapolated to similar schools in PMB or in the province. Time and cost constraints prevented an investigation into the dietary practices, attitudes towards nutrition and eating habits of the adolescent rugby players. As a result, a clear understanding regarding the reason why certain trends in terms of general- and sports-related nutrition knowledge were documented, was not evident. Similar to Walsh *et al* (2011) there was no control group was added to the population thus no benchmark for an acceptable nutrition knowledge score could not be generated.

6.6 Recommendations for future research

To increase the sample size, it is recommended that all urban, secondary government schools that offer rugby as an extramural sport in the PMB or the KZN region should be included in the study sample. The sample size could be further expanded by using any urban secondary school in PMB or surrounding areas, irrespective of whether they are a government or private school.

Similar future research should adapt the questionnaire to include questions regarding the attitudes, habits and practices of adolescent rugby players as well as their opinion regarding nutrition education (it has been established that nutrition education is necessary but the reception of that information will be determined by the enthusiasm of the target audience at which the education is aimed Zinn *et al* (2006)). A study conducted on adolescent swimmers in Trinidad and Tobago (Webb & Beckford 2013), suggest that there is a correlation between the age of the athlete and their attitude

towards nutrition. By including study variables such as the above, it could serve as justification for depicting a particular trend or belief regarding general- and sports-related nutrition knowledge and attitude towards nutrition and nutrition education among South African adolescent rugby players.

The survey questionnaire should undergo the test-retest method to increase the validity and reliability of the study results. Drost (2011) indicates that the test-retest reliability method denotes the procedure whereby a particular questionnaire is used to obtain results from one sample group and the same testing process is used on another sample group to obtain results. These results would then be compared and the correlation seen between the scores of the same test that was conducted on two separate sample sizes is referred to as the test-retest reliability (Drost 2011). Perhaps the questionnaire should also include more difficult questions to test the depth of nutrition knowledge and the level of nutrition education required.

Future studies in this field should adapt the questionnaire to include additional questions regarding areas where subjects that did not score well, namely carbohydrates, weight management, protein, well-balanced meals and supplement usage. This will help to determine the extent to which these areas are misunderstood as well as validate whether this is in fact an issue and trend seen in adolescent rugby players.

In addition, the questionnaire could be adapted to include more options for ‘sources of information’, specifically coaches, as it is evident from the literature that the literature that coaches plan an integral role when it comes to adolescent rugby players beliefs, attitudes, behaviours and development.

Finally measuring the body composition (e.g. BMI, body fat %) of adolescent rugby players could also be an additional objective for future studies of this nature, as this information could then be used to analyse the relationship between body composition and nutrition knowledge amongst adolescent rugby players as well as their attitudes, eating habits and behaviours.

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UNIVERSITY OF KWAZULU-NATAL

APPENDIX A:

GENERAL AND SPORTS-RELATED NUTRITION KNOWLEDGE QUESTIONNAIRE

Instructions

Section A: This involves questions that require the answers **YES/ NO** or **TRUE/ FALSE.** Make a cross/tick in the appropriate box.

Section B: This involves multiple choice questions that require you to make a cross/tick at the appropriate answer.

Section C: Follow the instructions on how to answer each question.

Confidentiality is assured as your name is not required to be given and the answers to these questionnaires will not be able to be traced back to you.

Please ensure you have completed the informed consent form before continuing with this questionnaire.

Please finish answering all the questions before moving on to the next ones and don't page back.

Please answer as honestly and accurately as you can.

PLEASE FILL IN YOUR DETAILS BELOW

CODE	L N
DATE	D M Y 20
AGE	
DATE OF BIRTH	D M Y
RESIDENCE	BORDER / DAY SCHOLAR
TEAM	
RACE	AFRICAN / INDIAN / WHITE / COLOURED
POSITION ON THE TEAM	

SECTION A

1.	You should eat a lot of sugar to have enough energy	TRUE	FALSE
2.	You should add extra salt to your cooked food before you eat it	TRUE	FALSE
3.	If you are eating a healthy diet there is no need for you to be physically active	TRUE	FALSE
4.	All water is safe to drink	TRUE	FALSE
5.	Your body only needs a little bit of salt to be healthy	TRUE	FALSE
6.	Sugar and foods that contain sugar should be eaten in small amounts	TRUE	FALSE
7.	Eating a lot of different kinds of foods is healthier than eating only a few kinds of foods	TRUE	FALSE
8.	Sugar contains a lot of vitamins and minerals	TRUE	FALSE
9.	It is impossible to get all the vitamins and minerals you need from food, you need to take a vitamin and mineral pill	TRUE	FALSE
10.	Starchy foods should not be eaten when one is trying to lose weight	TRUE	FALSE
11.	Eating bread always causes weight gain	TRUE	FALSE
12.	It is healthy to snack on foods that contain a lot of sugar	TRUE	FALSE
13.	You can eat as much meat as you want everyday	TRUE	FALSE
14.	Dry beans, peas, lentils are a healthy choice to eat in place of meat	TRUE	FALSE

15.	I supplement my diet with food items/ alternatives	TRUE	FALSE
16.	It is necessary to supplement your diet (use supplements) to build mass	TRUE	FALSE
17.	Fats are necessary in your diet as they provide additional energy and vitamins	TRUE	FALSE
18.	There is a difference between good and bad fats in food	TRUE	FALSE
19.	Pre- workout meals/ drinks should contain carbohydrates	TRUE	FALSE
20.	Caffeinated energy drinks are necessary for an energy boost before practice or a game	TRUE	FALSE
21.	There is a difference between a sport drink and an energy drink	TRUE	FALSE
22.	My diet changes between pre, during and post season	TRUE	FALSE
23.	What I eat affects my performance, recovery and body composition more than additional supplements	TRUE	FALSE
24.	Post workout meals/ drinks should contain carbohydrates	TRUE	FALSE

SECTION B

1.	You should not have starches at most meals because	a.	They are not important for your health
		b.	Even eating small amounts can cause weight gain
		c.	They cause diseases
		d.	None of the above

2.	How much water should you drink a day?	a.	You don't have to drink water everyday
		b.	1 to 3 glasses
		c.	4 to 6 glasses
		d.	7 to 9 glasses

3.	Which of the following is a low fat snack	a.	"Simba" Chips
		b.	Popcorn
		c.	Fried chips
		d.	"Niknaks"

4.	From which group of foods should you eat the most every day?	a.	Bread, samp, rice, porridge
		b.	Apples, bananas, spinach, carrots
		c.	Milk, yogurt, cheese
		d.	Chicken, fish, beans, eggs

5.	The key to a healthy way of eating is to	a.	Eat many different kinds of foods
		b.	Eat some foods more than other foods
		c.	Eat certain kinds of foods in moderate or small amounts
		d.	All of the above

6.	Which foods contain a lot of calcium?	a.	Chicken and eggs
		b.	Milk, yoghurt
		c.	Pilchards
		d.	b and c

7.	Being physically active means	a.	Going to the gym
		b.	Walking a lot
		c.	Playing sports like soccer or rugby
		d.	All of the above

8.	How many fruits and vegetables should be eaten?	a.	1 fruit and vegetable a day
		b.	3-4 fruits and vegetables a day
		c.	5 or more fruits and vegetables everyday
		d.	There is no need to eat fruits and vegetables daily

9.	How much milk or maas should be consumed per day?	a.	None
		b.	Half a cup
		c.	One cup
		d.	Two cups

10.	A well- balanced diet	a.	Consists mostly of meat, with smaller amounts of starch, fruits, vegetables, and dairy products
		b.	Consists mostly of vegetables, and smaller amounts of meat and dairy products
		c.	Consists mostly of starches, vegetables and fruits, with smaller amounts of meat and dairy products
		d.	None of the above

11.	Which of the following breakfast menus contain little fat	a.	Whole-wheat toast with thinly spread margarine
		b.	Weet-Bix with 2% fat milk
		c.	Bacon and egg
		d.	a and b

12.	Which food has the most fibre?	a.	What is fibre?
		b.	Brown bread
		c.	White bread
		d.	Whole wheat bread

13.	The reason why beans, peas and lentils are good for you is that	a.	They contain only small amounts of fat
		b.	They contain a lot of fibre
		c.	They can protect you from some diseases
		d.	All of the above

14.	It is important to stay hydrated	a.	Before, during and after exercise
		b.	During exercise
		c.	During and after exercise
		d.	After exercise

15.	The following energy drinks contain caffeine	a.	Red Bull
		b.	Monster
		c.	Lucozade
		d.	All of the above

16.	An appropriate beverage to drink during a workout is	a.	Coca cola
		b.	Powerade
		c.	Monster
		d.	All of the above

SECTION C

1. From where do you get your nutrition information? (make a **X** in one or more of the boxes)

   School ☐
   Peers/ friends ☐
   Parents ☐
   Media (magazines, radio, TV) ☐
   Other (specify below) ☐

   ---

2. Do you use sports or nutritional supplements? (Make a X over your answer) **YES** **NO**

   2.1. If **YES** how often?

   ☐ Daily
   ☐ 3-4 times per week
   ☐ Once or twice per week
   ☐ Once a week
   ☐ Less than weekly

   2.2. If **YES** what do you most frequently use? (select one of the following and give product names where appropriate)

   ☐ Protein shake e.g. Whey protein Product:----------
   ☐ Creatine Product:----------
   ☐ Fat- burner e.g. Phedra-Cut Product:----------
   ☐ Amino Acids e.g. Glutamine Product:----------
   ☐ Energy drinks e.g. Powerade Product:----------
   ☐ Mass Builder e.g. Muscle fuel Product:----------
   ☐ Meal replacements e.g. Ensure Product:----------
   ☐ Other Product:----------
   ☐ I'm taking a supplement but do not know what it is.

3. Would you consider taking a non- food supplement if it would improve your sporting performance or help you achieve your goals? **YES NO**

4. Have you made changes to your diet to help you achieve your goals? **YES NO**
   If **YES,** tick the appropriate boxes

   - ☐ Increased portions of carbohydrate foods
   - ☐ Decrease portions of carbohydrate foods
   - ☐ Included snacks between meals
   - ☐ Planned snacks around exercise
   - ☐ Cut out snacking between meals
   - ☐ Healthier food choices, no junk food
   - ☐ More vegetables and fruit
   - ☐ Increased portions of protein foods
   - ☐ Decreased portions of protein foods

   Other: ----------

5. Rate on a scale of 1-5 how important you think each of the following is in helping you achieve your goals

1=Not important **2=**Helps a little **3=**Fairly important **4=**Very important **5=**Critical, can't achieve without it. (Select the most appropriate number by circling it).

a.	Your exercise/ practice sessions	1	2	3	4	5
b.	Doing gym (weight) training	1	2	3	4	5
c.	Your diet/ what you eat	1	2	3	4	5
d.	Rest	1	2	3	4	5
e.	The supplements you take	1	2	3	4	5

6. Do you think that the carbohydrate-rich foods you eat before, during or after training can affect your performance? (Make a X over your answer)
   YES NO I DON'T KNOW

7. Are you taking a supplement to benefit your performance that may have negative side-effects but you are unsure? **YES NO**

8. Are you using a pre-workout supplement? **YES** **NO**

9. If so, what is the name and brand of the pre-workout? ----------
---

10. When is it most important to eat carbohydrate rich foods? (Make an X over your answer)
BERFORE TRAINING **DURING TRAINING** **AFTER TRAINING**

THANK-YOU FOR TAKING THE TIME TO COMPLETE THIS SURVEY

PARENTAL INFORMATION AND INFORMED CONSENT FOR RUGBY PLAYERS 14 YEARS OF AGE AND YOUNGER, PARTICIPATING IN RESEARCH INVESTIGATING GENERAL AND SPORTS-RELATED NUTRITION KNOWLEDGE OF SECONDARY SCHOOL RUGBY PLAYERS

APPENDIX B1:

Dear Parent,

My name is Bridgitte Stegen (BSc Dietetics, Post Grad Diploma in Dietetics). I am currently conducting research in order to obtain my masters in Dietetics through the University of KwaZulu-Natal. Your son is hereby invited to participate in this research project as he is a member of the respective rugby teams at his school.

STUDY INFORMATION

Study title: General and sports-related nutrition knowledge of male adolescent rugby players attending an urban government school in Pietermaritzburg, KwaZulu-Natal.

Method: The study will involve the completion of a self-administered questionnaire regarding your son's knowledge of general- and sports-related nutrition. It will also include a few other questions regarding your son that will enable me to have a better understanding of what he as a rugby player perceives to be important in order to enhance his performance. Please note that your son's answers to this questionnaire are anonymous. In other words I will not be able to trace his answers back to you as he will be allocated a code in order to ensure anonymity. It is estimated that the questionnaire will take about 30 minutes to complete.

Participation: Should you or your son have any further questions or concerns, you or your son can contact me, my study supervisors or Mrs. Snyman at the Human and Social Science Research Ethics Committee;

Researcher:	**Supervisors:**	**Human & Social Science Research Ethics Committee (HSSREC)**
Bridgitte Stegen	Prof. Fredrick Veldman	Mrs. Mariette Snyman
Cell: 072 719 6550	Tel: 033 260 5453	Tel: 031 260 8350
Email: bridgittes591@gmail.com	Email: veldmanf@ukzn.ac.za	Fax: 031 260 3093
	Mrs. Suna Kassier	Email: snymanm@ukzn.ac.za
	Tel: 033 260 5431	
	Email: kassiers@ukzn.ac.za	

Benefits: There are no immediate benefits as a result of your son's participation. However, your son will be provided with the results of this study upon its completion. In addition, a presentation based on

the 'gaps' in your son's nutrition knowledge as per the study findings will be conducted at his school to enhance his nutrition knowledge.

Ethics approval: This study received ethics approval from the UKZN Ethics Committee for Humanities and Social Sciences.

In order to indicate your willingness to participate in this study, kindly complete and sign the section that follows and fax or email the form to the Director of Rugby, Mr. Ryan Strudwick at Fax: 086 730 9273 or Email: strudwickr@mcollege.co.za.

INFORMED CONSENT FORM

I, _____ declare that the purpose of the study has been explained to me and understand that participation of my son in this study is voluntary.

I hereby consent to voluntarily participation in the above mentioned study.

Participant Name…….

Parent Name…….

Participant Signature……. Date……

Parent Signature…… Date…….

Witness Name……

Witness signature……..Date……..

Researcher Name……..

Researcher signature ……... Date……

PARTICIPANT INFORMATION AND INFORMED CONSENT FOR RUGBY PLAYERS PARTICIPATING IN RESEARCH INVESTIGATING THE GENERAL AND SPORTS-RELATED NUTRITION KNOWLEDGE OF SECONDARY SCHOOL RUGBY PLAYERS 2014

APPENDIX B2:

Dear Scholar,

My name is Bridgitte Stegen (BSc Dietetics, Post Grad Diploma in Dietetics). I am currently conducting research in order to obtain my masters in Dietetics through the University of KwaZulu-Natal. You is hereby invited to participate in this research project as you are a member of the respective rugby teams in your school.

STUDY INFORMATION

Study title: General and sports-related nutrition knowledge of male adolescent rugby players attending an urban government school in Pietermaritzburg, KwaZulu-Natal.

Method: The study will involve the completion of a self-administered questionnaire regarding your knowledge of general- and sports-related nutrition. It will also include a few other questions regarding you that will enable me to have a better understanding of what you as a rugby player perceives to be important in order to enhance your performance. Please note that your answers to this questionnaire are anonymous. In other words I will not be able to trace your answers back to you as you will be allocated a code in order to ensure anonymity. It is estimated that the questionnaire will take about 20 minutes to complete.

Participation: Should you have any further questions or concerns, you can contact me, my study supervisors or Mrs. Snyman at the Human and Social science Research Ethics Committee;

Researcher:	**Supervisors:**	**Human & Social Science Research Ethics Committee (HSSREC)**
Bridgitte Stegen	Prof. Fredrick Veldman	Mrs. Mariette Snyman
Cell: 072 719 6550	Tel: 033 260 5453	Tel: 031 260 8350
Email: bridgittes591@gmail.com	Email: veldmanf@ukzn.ac.za	Fax: 031 260 3093
	Mrs. Suna Kassier	Email: snymanm@ukzn.ac.za
	Tel: 033 260 5431	
	Email: kassiers@ukzn.ac.za	

Benefits: There are no immediate benefits as a result of your participation. However, you will be provided with the results of this study upon its completion. In addition, a presentation based on the 'gaps' in your nutrition knowledge as per the study findings will be conducted at your school to enhance your nutrition knowledge.

Ethics approval: This study received ethics approval from the UKZN Ethics Committee for Humanities and Social Sciences.

In order to indicate your willingness to participate in this study, kindly complete and sign the section that follows:

INFORMED CONSENT FORM

I, _____ declare that the purpose of the study has been explained to me. I understand that participation is voluntary.

I hereby consent to voluntarily participation in the above mentioned study.

Participant Name……..

Participant Signature…….. Date……

Witness Name……

Witness signature……..Date……..

Researcher Name……..

Researcher signature ……... Date……..

APPENDIX D:

8 April 2014

To Whom It May Concern;

RE: Bridgitte Stegen Masters study at Maritzburg College

This letter serves to confirm that we at Maritzburg College Rugby Department are fully supportive of the study that Bridgitte Stegen would like to do on our rugby players for her Masters.

We are excited about the study she would like to undertake and look forward to seeing the results she comes up with. We will give her all the necessary support and information she needs during this time of her study.

Please do not hesitate to contct me if you require any further information.

Kind Regards

MARITZBURG COLLEGE

Ryan Strudwick

Director of Rugby

51 College Road Pietermaritzburg 3201 | PO Box 398 Pietermaritzburg 3200

TEL +27 (0)33 342 9376 FAX 086 730 9273 CELL 0822230101

E-MAIL: strudwickr@mcollege.co.za **WEBSITE: www.maritzburgcollege.org.za**

HONESTY * INTEGRITY * COURAGE * SELF-DISCIPLINE * COMMITMENT * RESPECT

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 July 2014

Ms Bridgitte Marisa Stegen (210503527)
School of Agricultural, Earth & Environmental Sciences
Pietermaritzburg Campus

Protocol reference number: HSS/0425/014M
Project title: General- and sports-related nutrition knowledge of male adolescent rugby players attending a secondary urban government school in Pietermaritzburg, KwaZulu-Natal

Dear Ms Stegen,

Full Approval – Expedited Application

In response to your application dated 13 May 2014, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/ms

Cc Supervisors: Mrs SM Kassier and Prof FJ Veldman
Cc Academic Leader Research: Professor O Mutunga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za