NUTRITION KNOWLEDGE AND NUTRITIONAL ADVICE PRACTICES OF NETBALL COACHES IN THE FREE STATE

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Dissertation submitted in fulfilment of the requirement is respect of the Magister Scientiae: Dietetics degree qualification

In the Department of Nutrition and Dietetics,

Faculty of Health Science

At the University of the Free State

BLOEMFOTNEIN

2019

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DECLARATION

I, Karla Pretorius (née Mostert) hereby declare that this master's research dissertation or publishable interrelated articles that I herewith submit at the University of the Free State is my independent work and that I have not previously submitted it for qualification at another institution of higher education. I further cede copy right of this research report in favour or the University of the Free State.

Signed: 

Date: **January 2019**

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the following for making this study possible:

- My supervisor, Mrs Marizeth Jordaan, co-supervisor, Dr Ronette Lategan-Potgieter from the Department of Nutrition and Dietetics for their advice, assistance and encouragement;
- Mr Cornel van Rooyen, for his guidance regarding the statistical analysis of the data;
- Me Danila Liebenberg for her assistance regarding the questionnaire development;
- The under 16 and under 18 Free State Netball coaches for participating in the study;
- My husband and parents, for their continuous support, belief and encouragement.

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LIST OF ABBREVIATIONS

ACSM	American College of Sports Medicine
ADA	American Dietetic Association
DC	Dietitians of Canada
ISSN	International Society for Sport Nutrition
NCAA	National Collegiate Athletic Association
UKCC	United Kingdom coaching certificate

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SUMMARY

This study described the demographic background and facilities available, as well as the nutrition knowledge and advice practices of coaches that train under 16 and under 18 netball players in the first or second netball league in the Free State. A descriptive study was conducted using an online questionnaire.

Ethical approval was obtained from the Health Sciences Research Ethics Committee (HSREC 185_2016) of the Faculty of Health Sciences, University of the Free State and Netball South Africa. The contact information of coaches was obtained from the Free State Netball Federation.

Coaches were informed about the study and invited to participate via email. Participation was encouraged by sending out a follow-up invitation to all coaches, one month later, while an incentive in the form of a coaching course and netball equipment was offered to a randomly selected coach who participated in the study.

Forty four coaches are involved in coaching u/16 and u/18 netball in the Free State, all of whom were invited to participate. Only 34 completed the questionnaire. Coaches were asked to complete and online questionnaire that was used to determine facilities available to coaches, nutrition knowledge and advice practices of coaches. The median knowledge score of the coaches was 64.7%, indicating that the coaches in this study did not display adequate nutrition knowledge. Only four out of thirty four coaches achieved an adequate nutrition score of above 75%. Despite not using similar questionnaires, the knowledge scores obtained were comparable to other related studies.

Demographic background data investigated did not so show significant differences in nutrition knowledge of coaches and the team coached, age, ethnicity, gender, netball league, coaching level, number of years coaching, previous nutrition education or training received, healthcare support and facilities available to coaches. Only a small percentage (29.4%) of coaches received formal education or training in nutrition. Just over half (58.8%) of the coaches had healthcare support available, with 41.2% of coaches having no support available. The most common healthcare support available included strength and conditioning trainers (32.4%) and a physiotherapist (23.5%).

Coaches best understood questions related to “pre- training/competition and during training/competition food” and “weight loss”; scoring 80.0% and 75.0% for these sections, respectively. Questions on “recovery” and “supplement and ergogenic aids” had the lowest overall median correct score, of 50.0% each.

Majority of coaches (82.3%) read about nutrition related issues. The internet (55.6%) was the most popular source of nutrition information. It was expected that those who read about nutrition related issues would display a better nutrition knowledge, however, no significant difference was found between the median knowledge correct score of coaches who read about nutrition compared to those who did not.

All coaches believed that good nutrition practices can improve sports performance, yet, only a small percentage (29.4%) were trained in nutrition and/or had adequate nutrition knowledge.

Over half (55.9%) of the coaches reported that they provide advice to their netball players. No significant difference in knowledge scores between coaches who gave advice and those who did not give advice was found.

Most of the coaches (78.1%) have never made use of a professional to give nutrition advice to their players. Of the small percentage (21.9%) that did utilise a professional, most used doctors (57.1%). Dietitians (42.9%), sports nutritionists (28.6%), strength and conditioning trainers (28.6%) and physiotherapists (14.3%) were also used by coaches. Among the coaches providing advice on nutrition, 23.5% made use of outside professionals. Of the few (21.9%) coaches that made use of professionals, mostly professionals that may not be knowledgeable to deliver nutrition advice or where nutrition did not form part of their scope of practice, were used.

A large body of evidence on sports nutrition and its importance in exercise performance as well as overall health exists. The provision of good nutrition advice and information to netball players as well as other athletes is an area that clearly needs attention. Optimal strategies to increase coaches’ knowledge should be researched and/or created to provide assistance. Continued education programmes should be implemented, as part of the requirements as set forth by Netball South Africa, on a regular basis to ensure that athletes and coaches have sufficient nutrition knowledge and have access to reliable nutrition information.

1. ORIENTATION TO THE STUDY

1.1 BACKGROUND AND MOTIVATION

Over the last 20 years, research on sports nutrition and its importance in exercise performance has developed significantly (ADA/DC/ACSM, 2016:501). It is clear that optimal nutrition forms an essential part of any training programme (ADA/DC/ACSM, 2016:504; Bean, 2017:13) and not only enhances performance and overall health, but promotes healthy dietary practices in the years to come as well (Cockburn et al., 2014:1443; ADA/DC/ACSM, 2016:504; Bean, 2017:231).

The American College of Sports Medicine (ACSM), American Dietetic Association (ADA), and Dietitians of Canada (DC) provides guidelines on energy, nutrient, and fluid recommendations for elite athletes and for physically active individuals (ADA/DC/ACSM, 2016:501). The most important component for successful exercise and performance through nutrition is to ensure the athlete is consuming enough energy to support energy expenditure and to maintain strength, endurance and muscle mass (Botsis and Holden, 2015:194; ADA/DC/ACSM, 2016:504). Despite general healthy eating guidelines and international sports nutrition recommendations (ADA/DC/ACSM, 2016:501), inadequate dietary practices are prevalent among athletes (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Sangeetha et al., 2014:973; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Valliant et al., 2012:510; Shriver et al., 2013:13; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20).

Valliant et al. (2012:510) investigated the energy and macronutrient intake of a National Collegiate Athletic Association (NCAA) female volleyball team (between the age of 19 and 22 years) over two off-seasons in the United States. In this study, it was reported that athletes displayed a lack of nutrition knowledge, showing misconceptions especially about macronutrient needs and vitamin and mineral requirements (Valliant et al., 2012:513). This lack of knowledge, often results in poor eating habits and disordered eating (Cotugna et al., 2005:326).

Several studies have shown that athletes rely on coaches for nutrition direction who

serve as one of the primary sources of nutritional information (Valliant et al., 2012:513; Couture et al., 2015:326; Botsis and Holden, 2015:197; Hoogenboom et al., 2009:147). This might be due to the important position they take up in a team environment and the relationships between athletes and coaches (Torres-McGehee et al., 2012:207).

Many coaches do not have any formal nutrition training or education (Juzwiak and Ancona-Lopez, 2004:224; Cockburn et al., 2014:1447; Salami et al., 2017:3), and only a small percentage of coaches make use of professionals like dietitians to obtain nutrition advice (Zinn et al., 2006:220; Juzwiak and Lopez, 2004:225; Torres-McGehee et al., 2012:208; Cockburn et al., 2014:1448; Couture et al., 2015:328; Salami et al., 2017:3).

Of the 168 New Zeeland premier club rugby coaches, included in a study by Zinn et al. (2006:217), 83.8% of the coaches advised their athletes on nutrition. This finding was similar to studies conducted amongst coaches in Lebanon (Salami et al., 2017:4), the United Kingdom (Cockburn et al., 2014:1449) and Canada (Couture et al., 2015:328). Coaches all over the world provide nutrition advice to their athletes (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:222; Zinn et al., 2006:221; Cockburn et al., 2014:1445; Couture et al., 2015:328; Salami et al., 2017:2) even though they lack sufficient knowledge. Thus, the quality and credibility of the information provided to athletes remains highly questionable and further investigation is needed.

1.2 PROBLEM STATEMENT

To athletes, coaches often act as their main source of information (Botsis and Holden, 2015:197; Jacob et al., 2016:1308), especially regarding nutrition. Coaches have the authority and responsibility within the team to make important decisions and influence young athletes. It is therefore important for coaches to provide correct and accurate information (Botsis and Holden, 2015:198). More emphasis should be placed on nutrition education of coaches to ensure better nutrition knowledge amongst athletes and coaches (Jacob et al., 2016:1313). Various authors have concluded that it is important to ensure coaches obtain information from reliable sources and receive ongoing nutrition training in order to best support their athletes (Zinn et al., 2006:224; Torres-McGehee et al., 2012:211; Cockburn et al., 2014:1451).

Good nutrition is not only important for successful exercise and competition performance of the growing adolescent (ADA/DC/ACSM, 2016:521), it is also vital for development, growth and overall health (Cockburn et al., 2014:1443).

To date, limited nutrition education information is included in Netball South Africa's National Coaches' Association guidelines and information curriculum. Evaluation of the nutrition knowledge and correctness of nutritional advice provided by coaches is thus very important, as the identification of these gaps amongst coaches, will assist in the development and implementation of targeted nutrition education programmes and/or advocate for uptake by coaches to existing programmes. It may further advocate for resources to support coaches to have access to such programmes.

1.3 RESEARCH QUESTION

Only a few studies have been conducted to determine the nutrition knowledge of netball coaches, but to date, no study has been published that describes the nutrition knowledge and nutritional advice practices of these coaches in South Africa. The purpose of the study was, therefore, to determine the nutrition knowledge and nutritional advice practices of u/16 and u/18 first or second netball league coaches in the Free State.

1.4 AIM AND OBJECTIVES

The aim of the study was to determine the nutrition knowledge and nutritional advice practices of first or second league coaches of u/16 and u/18 netball players in the Free State.

1.4.1 OBJECTIVES

In order to reach the aim, the following objectives were set:

- To describe the demographic characteristics and facilities available to coaches that train u/16 and u/18 netball players in the first or second netball league.
- To determine the nutrition knowledge of u/16 and u/18 netball coaches regarding sports nutrition.
- To determine the nutritional advice provided by u/16 and u/18 netball coaches to netball players.

1.5 STRUCTURE OF DISSERTATION

The dissertation is presented in article format, with the following chapters guiding the reader through the process, results and discussion.

Chapter 1 serves as an introductory chapter that provides an overview of the study. Chapter 2 comprises a literature review that provides more information on sports nutrition principles for young athletes, nutrition knowledge and nutritional advice practices among coaches, nutrition knowledge and nutrition practices of athletes and different nutrition interventions. Chapter 3 explains the methodology followed in the study and chapters 4 and 5 are structured as a series of articles, each written according to a study objective according to the applicable author instructions of the specific journal.

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New Zealand Premier Club Rugby Coaches. International Journal of Sport Nutrition and Exercise Metabolism, 16: 217, 220, 221,224.

2. LITERATURE REVIEW

2.1 INTRODUCTION

Good nutrition is considered to be the single most important factor affecting performance in any physically active individual, regardless of the sport type and competing level (Potgieter, 2013:6; ADA/DC/ACSM, 2016:501). Not only is optimal nutrition important for athletic performance, but sound nutrition is also vital for development, growth and overall health, especially in the growing adolescent (Bean, 2017:231).

Research on sports nutrition and the relationship between proper nutrition, performance and health has grown rapidly over recent years (ADA/DC/ACSM, 2016:501; Bean, 2017:4), yet, athletes and coaches still lack appropriate nutrition knowledge and nutritional practices (Hoogenboom et al., 2009:144 Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Torres-McGehee et al., 2012:206; Spendlove et al., 2012:1872; Valliant et al., 2012:510; Shriver et al., 2013:12; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20).

Athletes rely on a wide variety of resources for nutrition guidance, including physicians, dietitians, peers, teammates, family, the media, independent research and coaches (Rockwell *et al.*, 2001:181; Juzwiak and Ancona-Lopez, 2004:224; Zinn *et al.*, 2006:220; Cockburn *et al.*, 2014:1447; Couture *et al.*, 2015:328; Salami *et al.*, 2017:4). Several studies have shown that coaches are one of the main sources of nutritional information for young athletes (Hoogenboom *et al.*, 2009:147; Hornstorm *et al.*, 2011:113; Walsh *et al.*, 2011:369; Torres-McGehee *et al.,* 2012:209; Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore *et al.*, 2017:6).

Various studies have concluded that coaches have poor nutrition knowledge and are not accurately informed to communicate nutritional information, strategies and/or make recommendations to athletes (Rockwell *et al.*, 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn *et al.*, 2006:224; Torres-McGehee *et al.*, 2012:209; Cockburn *et al.*, 2014:1447; Botsis and Holden, 2015:198; Couture *et al.*, 2015:332; Jacob *et al.*, 2016:1311; Salami *et al.*, 2017:6).

Coaches make important decisions and rulings within the team and can thus influence young athletes. It is therefore important for coaches to provide correct and accurate information (Botsis and Holden, 2015:198). More emphasis should be placed on nutrition education or training of coaches to ensure better nutrition knowledge amongst coaches and athletes (Rockwell *et al*., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn *et al*., 2006:224; Torres-McGehee *et al*., 2012:209; Cockburn *et a*l., 2014: 1447; Couture *et al*., 2015:332; Jacob *et al*., 2016:1313; Salami *et al*., 2017:6).

This literature review is aimed at clarifying the nutrition knowledge and advice practices of coaches, nutrition knowledge and nutritional practices of athletes and to make a comparison between different nutrition interventions recommended and implemented by several authors. By determining the nutrition advice that coaches give to athletes, dietitians and nutritionists can be assisted to identify knowledge deficiencies amongst coaches, in order to develop appropriate intervention strategies.

2.2 NUTRITION KNOWLEDGE AND NUTRITIONAL ADVICE PRACTICES OF COACHES

Coaches have direct and regular contact with athletes, and therefore play a major role in their development as well as health and performance (Zinn *et al*., 2006:214). Not only do they provide nutrition guidance, but are also responsible for the monitoring of nutritional practices of their athletes. They take up a position in a team sport that gives them the power and responsibility to make important decisions regarding many aspects of the team, which also gives them a significant opportunity to influence young athletes (Cockburn *et al*., 2014:1443; Couture *et al*., 2015:332; Salami *et al*., 2017:6). Coaches are basically present at every training session and can observe the food and fluid intake before, during and after training sessions (Zinn, 2004:35).

Torres-McGehee et al. (2012:206) identified resources of nutrition information, determined nutrition knowledge as well as confidence levels in terms of nutrition knowledge among athletes, coaches and trainers from different National Collegiate Athletic Association Division I, II, and III institutions across the United States. Athletes (43%) were found to turn to their coaches for nutrition advice (Torres-McGehee *et al*., 2012:208), which was similar to findings of other studies (Hornstorm *et al*., 2011:113; Walsh *et al*., 2011:369; Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore *et al*., 2017:6). Therefore, it is critically important that

coaches provide accurate information to athletes to ensure that they remain healthy and can perform at their optimal level.

Various studies consisting of a variety of team and individual sports, each with their own sport-specific questionnaire, have investigated nutrition knowledge and nutritional advice practices of coaches. Table 2.1 summarises the main findings from different studies of coaches' nutrition knowledge, nutritional advice practices and the sources of information they utilise. Coaches from different countries and sporting types seem to have similar results in terms of nutrition knowledge and nutritional advice practice recommendations (Rockwell *et al*., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn *et al*., 2006:224; Cockburn *et al*., 2014:1447; Couture *et al*., 2015:332; Jacob *et al*., 2016:1313; Salami *et al*., 2017:6).

Table 2.1: Summary of studies investigating the nutrition knowledge and nutritional advice practices of coaches in various sport types

Study and Country	Sample Size and Description	Sporting Code	Nutrition Knowledge and Practice	Nutrition Training	Source of Information	Conclusion
Rockwell et al. (2001) United States of America	35 coaches, 18 athletic trainers, and strength and conditioning specialists from inter collegiate sports. (2001:177)	Basketball, football, volleyball, athletics, swimming, diving, basketball golf, softball, tennis, soccer. (2001:177)	**Knowledge** Mean score: 67%. (2001:177) **Practice** 94% recommended the use of nutritional supplements. (2001:179)	N/A	Magazines (47%), other (Internet, television, food labels) (42%), physicians (40%), books (40%), scientific journals (37%), dietitians (30%) and videos (11%). (2001:181)	Ongoing training, resources and support should be provided to coaches and trainers from qualified nutritionists/registered dietitians. (2001:184)
Juzwiak and Ancona-Lopez (2004) Brazil	55 coaches from different sports. (2004:224)	Gymnastic, tennis, swimming, judo. (2004:224)	**Knowledge** Mean score: 70%. (2004:227) **Practice** 100% gave nutritional advice during training, 93% pre training, and 46% post training. (2004:225) 27% recommended weight control practices. (2004:222) 27% recommended the use of nutritional supplements. (2004:227) 47% recommended athletes to see nutrition specialists. (2004:225)	41% attended nutrition courses. (2004:224)	Non-technical magazines (58%), textbooks (38%), other coaches (44%). (2004:224)	The role of trained coaches becomes important especially in certain circumstances where it is impossible to recruit a nutritionist/dietitian to work with athletes. Thus, ensuring that coaches have sufficient knowledge is vital in order for them to advise athletes appropriately. Providing compulsory nutrition courses and developing specific education materials, can assist in increasing nutrition knowledge of coaches. (2004:233)

Study and Country	Sample Size and Description	Sporting Code	Nutrition Knowledge and Practice	Nutrition Training	Source of Information	Conclusion
Zinn et al. (2006) New Zealand	168 New Zealand premier rugby coaches. (2006:217)	Rugby. (2006:214)	**Knowledge** Mean score: 55.6%. (2006:221) Mean correct score: Nutrients (61.5%), recovery (57.3%), fluid (54.7%), weight control (50.4%) and supplements (32.9%). (2006:219) **Practices** 83.8% gave nutritional advice. 95% imparted advice on fluid, 79% on nutrients, 34% on recovery, 39% on supplements and 27.0% on weight control. (2006:217)	38.7% of coaches received formal nutrition training. 42.1% of those coaches providing advice, received formal nutrition training. (2006:220)	Lecture/seminar or courses (57%), internet (34%), magazines (30%) personal cites which include: physiotherapists (19%), personal trainers (19%), trainers (15%), doctors (11%), and dietitians/nutritionists (7%). 18.0% did not made use of any information sources. (2006:220)	Coaches have inadequate sports nutrition knowledge and further training in sports nutrition is needed. Knowledgeable coaches become important especially in certain circumstances where it is impossible to recruit trained professionals. (2006:224)

Study and Country	Sample Size and Description	Sporting Code	Nutrition Knowledge and Practice	Nutrition Training	Source of Information	Conclusion
Torres-McGehee et al. (2012) United States of America	4 Domains: coaches, athletes, athletic trainers, and strength and conditioning specialists. National Collegiate Athletic Association Division I, II and III institutions. (2012:205)	Baseball, basketball, cheerleading, cross-country, equestrian, football, golf, gymnastics, ice hockey, lacrosse, rowing, soccer, swimming and diving, tennis, track and field, volleyball and wrestling. (2012:206)	**Knowledge** Overall average of 68.5% in all domains. (2012:205) Adequate knowledge found in 35.9% of coaches, 71.4% of athletic trainers, 83.1% of strength and conditioning specialist, and 9% of athletes. (2012:209) **Practice** Coaches recommended athletes to athletic trainers, strength and conditioning specialist and registered dietitians. (2012:205)	N/A	The most used nutrition resources for coaches, athletic trainers, and strength and conditioning specialist, were registered dietitians. Coaches made use of athletic trainers, strength and conditioning specialist and registered dietitians for nutrition information. Athletic trainers made use of academic journals, registered dietitians and physicians for nutrition information. Strength and conditioning specialist made use of athletic trainers, strength and conditioning specialist and registered dietitians for nutrition information. (2012:208)	Athletic trainers and strength and conditioning specialists displayed adequate sports nutrition knowledge, whereas coaches and athletes displayed inadequate knowledge. Ongoing nutrition training and education programmes should be delivered to coaches and athletes on regular basis presented by qualified professionals. (2012:209)
Cockburn et al. (2014) United Kingdom	163 UK coaching certificate (UKCC) level 2 and 3, hockey and netball qualified coaches. (2014:1443)	Netball, hockey. (2014:1444)	**Knowledge** Mean score: 35.4%. Mean correct score: Fluid (47.3%), recovery (62.3%), nutrients (69.3%), weight control (57.3%) and supplements (38.3%). (2014:1447) **Practices** 57.1% gave nutrition advice. 100% imparted advice on fluid, 82.8% on recovery, 40.9% on nutrients, 28.0% on weight	25.2% of coaches received formal nutrition training. 31.2% of those coaches providing advice, received formal nutrition training. (2014:1447)	Internet (61.1%), journal articles (48.9%), magazines (44.3%), lectures/seminars/courses (26.0%) and sponsors (1.5%). 19.6% of coaches did not read about sports nutrition related issues. (2014:1447) 14.7% made use of an outside professional (sports nutritionist (66.7%), physiotherapist (50.0%), team trainer	Coaches have inadequate nutrition knowledge. (2014:1451)

Study and Country	Sample Size and Description	Sporting Code	Nutrition Knowledge and Practice	Nutrition Training	Source of Information	Conclusion
			control and 15.1% on supplements. (2014:1445)		(37.5%), personal trainer (25%), registered dietitian/nutritionist (16.7%), academic (16.7%) and/or a doctor (8.3%). (2014:1448)	
Botsis and Holden (2015) United States of America	21 coaches from Division I National Collegiate Athletic Association (NCAA). (2015:196)	Women's volleyball, soft ball, men's and woman's track and cross country, football, men's and women's basketball. (2015:196)	**Knowledge** Mean Score: 55**%.** (2015:197)	N/A	N/A	Coaches may not be appropriate sources of information with regard to sports nutrition. (2015:198)
Couture et al. (2015) Canada	47 coaches from five high schools. (2015:328)	Coaches from sports categorized as "leanness" (e.g., gymnastic, swimming, cheerleading, etc.), sports categorized as "non-leanness" (e.g., basketball, football, tennis, badminton, etc.) and others non-leanness group, i.e., coaches involved in sports not focusing primarily on gaining mass and strength such as basketball, soccer, cross- country skiing. (2015:327)	**Knowledge** Mean score: 68.4%. (2015:328) Mean correct score: Lipids (71.5%), supplements (68.9%), weight management (68.1%) protein (67.2%) and carbohydrates (61.5%). (2015:329) **Practices** 60% gave nutritional advice. (2015:328) 100% imparted advice on hydration, 97.5% on food rich in protein, 47.6% on food rich in carbohydrates, 4.4% on supplements for muscle building and 2.5% on supplements for weight loss. (2015:330)	N/A	Internet (55%), friends (34%), TV (30%), colleagues (30%), dietitians (30%), documentation (25%), magazine (21%), newspapers (15%), physicians (8%), scientific papers (5%). (2015:328)	Coaches from different sports displayed similar general nutrition knowledge. Sports nutrition education and specific training on a regular basis is needed to help increase their knowledge, and they should be encouraged to make use of reliable sources of information. (2015:332)

Study and Country	Sample Size and Description	Sporting Code	Nutrition Knowledge and Practice	Nutrition Training	Source of Information	Conclusion
Salami et al. (2017) Lebanon	151 trainers. (2017:2)	Gymnastic, tennis, swim, basketball, football, judo. (2017:2)	**Knowledge** Mean score: 51.1%. (2017:5) Mean correct score: Nutrients (71.1%), recovery (59.1%) fluid (56.5%), weight control (52.2%) and supplements (34.7%). (2017:4) **Practices** 82.3% gave nutrition advice. 84.8% imparted advice on fluid, 79.5% on nutrients, 25.2% on recovery, 31.8 % on supplements and 19.9% on weight control. (2017:2)	26.5% underwent nutrition training. (2017:3)	Internet (60.9%), magazine (44.4%), lectures/seminars/courses (25.8%), journal articles (8.6%) and sponsors (1.3%). (2017:3) 14.6 % make use of outside professionals. (2017:4)	Trainers do not have adequate knowledge on sports nutrition and they cannot deliver accurate information to their athletes. Further and continuous training is needed. (2017:6)

N/A – NOT APPLICABLE

2.2.1 NUTRITIONAL ADVICE PRACTICES OF COACHES

Studies summarised in Table 2.1 found that between 57% and 100% of coaches are involved in providing nutritional advice (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:222; Zinn et al., 2006:221; Cockburn et al., 2014:1445; Couture et al., 2015:328; Salami et al., 2017:2). Of the 168 New Zealand coaches, 83.8% of the coaches advised their athletes on nutrition (Zinn et al., 2006:217), which was similar to a recent study where 82.8% of 151 coaches from Lebanon participated in nutrition advice practices (Salami et al., 2017:4). Some of the lower percentage of advice practices observed were among the United Kingdom and Canadian coaches (57.1% and 60%, respectively) (Cockburn et al., 2014:1449; Couture et al., 2015:328).

There are numerous reasons why coaches may not offer nutrition advice to their athletes. Firstly, coaches might not offer advice on nutrition, because they begin to understand the cardinal importance of nutrition and the effect it has on an athlete's overall health and performance, leading to the use of external professionals on a more frequent basis. Secondly, coaches may not have the confidence to give nutrition advice, as they have become increasingly aware that their level of nutrition knowledge is not up to standard. Some coaches may think that nutrition is not that important for the performance of their athletes, or that someone else will offer support to the athletes with regard to nutrition guidance. Furthermore, many coaches simply do not have the time to give such advice in addition to their already tight schedule and training programme (Cockburn et al., 2014:1445; Salami et al., 2017:2).

Various studies show that coaches demonstrate a lack of knowledge when it comes to nutrition (Rockwell et al., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn et al., 2006:224; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1447; Botsis and Holden, 2015:198; Couture et al., 2015:332; Salami et al., 2017:6), making them unsuitable sources to advise athletes appropriately.

Cockburn et al. (2014:1445) observed that hockey and netball coaches with a level 2 and 3 United Kingdom coaching certificate (UKCC), gave advice on fluids, yet their mean nutrition knowledge score on hydration was only 47.3%. It may be anticipated that they are providing advice in an area where they think they are knowledgeable, but in fact they are not (Cockburn et al., 2014:1449). In the same study, it was found that advice on supplements was only provided by 15.1% of coaches. This finding is

encouraging because this category had the lowest mean score out of all the different categories researched in the study (Cockburn et al., 2014:1445), indicating that the coaches chose not to give inaccurate advice on supplements. Similarly, a study conducted by Salami et al. (2017:4), found that only 20% of coaches gave advice on supplements, which potentially gives athletes the opportunity to seek information from more reliable sources.

Coaches tend to give advice on fluid (Juzwiak and Ancona-Lopez, 2004:226; Zinn et al., 2006:219; Cockburn et al., 2014:1445; Couture et al., 2015:330; Salami et al., 2017:4), nutrient types (Rockwell et al., 2001:179; Zinn et al., 2006:219; Cockburn et al., 2014:1445; Couture et al., 2015:330; Salami et al., 2017:4) , recovery (Juzwiak and Ancona-Lopez, 2004:227; Zinn et al., 2006:219; Cockburn et al., 2014:1445; Couture et al., 2015:330; Salami et al., 2017:4), supplements (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:227; Zinn et al., 2006:219; Cockburn et al., 2014:1445; Couture et al., 2015:330; Salami et al., 2017:4) and weight management (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:225; Zinn et al., 2006:219 Cockburn et al., 2014:1445; Salami et al., 2017:4).

A study by Couture et al. (2015:329) requested coaches to: “identify which nutritional practices they recommended to their athletes to enhance performance from a predetermined list which is divided into five categories: 1) use of supplements for muscle mass building, 2) use of supplements for weight loss, 3) consumption of foods rich in carbohydrates, 4) consumption of foods rich in proteins and 5) hydration recommendations”. The study found that the two most frequent recommendations that coaches made were related to hydration and the consumption of foods rich in protein.

The above-mentioned study also found that coaches understood the importance of hydration. Water, recovery drinks and juices were widely recommended to athletes as methods of hydration (Couture et al., 2015:332; Juzwiak and Ancona-Lopez, 2004:227). This finding was similar amongst hockey and netball coaches in Lebanon and the United Kingdom as well as New Zealand rugby coaches (Zinn et al., 2006:219; Cockburn et al., 2014:1449; Salami et al., 2017:4). Regardless of the fact that coaches responded correctly to most of the questions in studies by Zinn et al. (2006:219), Cockburn et al. (2014:1447) and Salami et al. (2017:4), a clear gap was identified between the nutrition knowledge of the coaches and their advice practices in relation

to hydration issues. Often fluid is not recommended in all stages of exercise, and the type and volume of fluid intake was not in accordance with established guidelines. Being hydrated before, throughout and after exercise is very important and also greatly contributes to optimal health and performance (ADA/DC/ACSM, 2016:514).

Other practices and recommendations identified by Couture et al. (2015:331) showed that less than half of the participants advised "the consumption of foods high in carbohydrate to enhance performance". Protein was recommended to athletes to help enhance their performance, promote recovery and maintain lean muscle. Studies emphasise that coaches do not understand the role of carbohydrates and proteins with regard to performance and other sports nutrition concepts (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:225; Couture et al., 2015:330).

Carbohydrates, which are an important source of energy for the human body, especially the brain, should provide at least 50% of the total daily energy requirements, while the rest should be provided by protein and fat (Cotugna, 2005:323). A limited amount of carbohydrates are stored in the muscles and liver as glycogen (Bean, 2017:33), and carbohydrate requirements are based on the amount of fuel the muscles need to replace during and after daily exercise to restore muscle glycogen stores (Burke and Cox, 2012:47). Protein is required for tissue repair, regulation of many metabolic pathways, hormone and enzyme production and can also be used as a fuel source during energy production (Bean, 2017:9).

It is evident from Table 2.1 that the use of supplements is frequently recommended to athletes (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:227), but this was not reported in studies by Zinn et al. (2006:219), Cockburn et al. (2014:1445), Couture et al. (2015:330) and Salami et al. (2017:4). Coaches in these studies indicated that they prefer not to give advice on supplements (Zinn et al., 2006:219; Cockburn et al., 2014:1445; Salami et al., 2017:4).

Furthermore, Couture et al. (2015:329) found that a high nutrition knowledge score was obtained in the supplement category between "leanness" and "non-leanness" amongst Canadian coaches, which explains the low occurrence of supplement suggestion among coaches, because they might have known that supplements are not the ideal solution to address a poor diet.

Should dietary deficiencies exist, efforts should first be made to correct dietary intake through food, as this is the healthier and preferred treatment option (Blumberg et al., 2018:12) due to the other nutrient and non-nutrient substances also present in food.

Many athletes have the desire to lose or gain weight in order to reach or maintain a competitive weight category (Bean, 2017:185). Different weight managing or monitoring behaviours have been observed among athletes, including weighing and assessing body fat composition (Rockwell et al., 2001:179). The different weight loss strategies that coaches recommend to their athletes include restricting food intake (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:231), performing extra workouts (Rockwell et al., 2001:179) or harmful weight loss practices such as wearing plastic or wool clothes, use of saunas and fasting for longer than four hours at a time (Juzwiak and Ancona-Lopez, 2004:231), which is concerning. To achieve weight control and muscle mass gain, approximately half of the coaches correctly recommended appropriate exercise and food intake. Some coaches, however, still erroneously believe that diet alone can promote weight and muscle mass gain (Juzwiak and Ancona-Lopez, 2004:231).

Safe weight loss practices are important to ensure performance and good health. The general recommendation to lose weight or to increase muscle mass involves a total energy reduction or energy increase combined with optimal training (Bean, 2017:186).

2.2.2 NUTRITION KNOWLEDGE OF COACHES

In the research reviewed in Table 2.1, coaches' nutrition knowledge scores ranged from 35% to 70% (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328; Salami et al., 2017:4), with the gymnastics-, tennis-, swimming- and judo coaches from Brazil who participated in the study by Juzwiak and Lopez (2004:227) obtaining the highest mean score of 70%.

In a recent study, (Salami et al., 2017:6) 151 gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches from Lebanon obtained a mean nutrition knowledge score of 51.1%, which was lower than most of the studies mentioned in Table 2.1 (Juzwiak and Ancona-Lopez, 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328).

Torres-McGehee et al. (2012:209) found that coaches scored 30% less in the adequate knowledge about nutrition category compared to athletic trainers and 43% less than strength and conditioning specialists. This study concluded that most of the participants (coaches, athletic trainers, and strength and conditioning specialists) had a reasonable knowledge of the nutritional requirements for athletes. However, in a more recent study conducted in 2014, it was found that coaches only obtained a mean correct score of 35.4%, which demonstrated a serious lack of sports nutrition knowledge (Cockburn et al., 2014:1445).

Torres-McGehee et al. (2012:206), used a minimum knowledge score of 75% when evaluating the level of nutrition knowledge of coaches. However, considerations should be made when using this minimum to make direct comparisons with other studies, as different questionnaires are used to evaluate knowledge. None the less, there was not a single coach in the studies listed in Table 2.1 that scored a mean nutrition knowledge score higher than 75%, thus implying that none of the coaches in these studies had adequate nutrition knowledge to make recommendations or give nutritional advice to their athletes.

Coaches who have rated their nutrition knowledge level as high, achieved significantly higher scores than those who rated their knowledge as low (Zinn et al., 2006:217, Salami et al., 2017:5). Coaches who provided advice obtained significantly higher nutrition knowledge scores than those who did not give advice (Salami et al., 2017:3). These findings were not observed in a study by Cockburn et al. (2014:1446), where no significant difference in nutrition knowledge scores were found between coaches who gave advice and those who did not.

Numerous studies investigated the relation between nutrition knowledge and various demographics, and included: the gender of the athletes who were coached (Rockwell et al., 2001:177; Botsis and Holden, 2015:197), the gender of the coach (Rockwell et al., 2001:177; Couture et al., 2015:329), years of experience (Rockwell et al., 2001:177; Botsis and Holden, 2015:197; Salami et al., 2017:5), level of coaching (Juzwiak and Ancona-Lopez, 2004:228; Couture et al., 2015:329; Salami et al., 2017:5), formal nutrition training received (Zinn et al., 2006:220; Cockburn et al., 2014: 1447; Salami et al., 2017:3) and different sport categories (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez, 2004:230; Couture et al., 2015:329).

A significant difference in nutrition knowledge score was observed among coaches who coached one gender and those who coached both genders, (Rockwell et al., 2001:177; Botsis and Holden, 2015:197), with coaches coaching both genders recording a better nutrition knowledge, with a score of 60% (Botsis and Holden, 2015:197). Regardless of the better score, these coaches still did not show adequate knowledge. No significant differences were found between mean nutrition knowledge scores when comparing male and female coaches in two other studies (Rockwell et al., 2001:177; Couture et al., 2015:329).

Coaches with more than 15 years of experience in a study by Rockwell et al. (2001:177) had significantly better nutrition knowledge scores, while no association was reported between coaching experience and nutrition knowledge scores in the studies by Botsis and Holden (2015:197) and Salami et al. (2017:5).

Level of training, including university education, showed a positive association with nutrition knowledge and nutritional practice recommendations (Couture et al., 2015:329). This was similar to findings published by Salami et al. (2017:5), but contrary to findings by Juzwiak and Ancona-Lopez (2004:228). Coaches who completed formal nutrition education outscored the ones who did not receive any form of formal nutrition training (Zinn et al., 2006:220; Cockburn et al., 2014: 1447; Salami et al., 2017:3).

No significant difference in mean nutrition knowledge scored was found between coaches involved in different sporting categories (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez, 2004:230; Couture et al., 2015:329).

Coaches who participated in the studies by Zinn et al. (2006:219), Cockburn et al. (2014:1446) and Salami et al. (2017:3) correctly answered significantly more questions in both nutrient and recovery categories, followed by fluid, weight control and supplements. In other studies, the coaches achieved their highest nutrition knowledge score in the supplements category and lowest score in the macro- and micronutrient category (Rockwell et al., 2001:178; Torres-McGehee et al., 2012:210). Couture et al. (2015:329) pointed out that hydration and weight management seemed to be better understood than the role of carbohydrates and protein.

All questions on weight control were answered incorrectly by the coaches in the study by Salami et al. (2017:3), which was similar to findings in other studies (Zinn et al., 2006:219; Cockburn et al., 2014:1446). Juzwiak and Ancona-Lopez (2004:225) reported a clear knowledge deficit related to weight control and strategies concerning pre-training, training/competition, and post-training. The role of protein in weight control was also not well understood by coaches (Zinn et al., 2006:219; Torres-McGehee et al., 2012:210).

Coaches make use of a variety of sources to obtain information on nutrition. The internet is one of the most common sources of nutritional information that coaches utilise (Cockburn et al., 2014: 1447; Couture et al., 2015:328; Salami et al., 2017:3). Journal and magazine articles are some of the other sources of information that coaches commonly make use of (Juzwiak and Ancona-Lopez 2004:224; Zinn et al., 2006:220; Cockburn et al., 2014:1447; Couture et al., 2015:328). Despite the availability of sources like the internet, journal and magazine articles, the trustworthiness of the information remains questionable and should be verified before the information is used (Cockburn et al., 2014:1443).

A small percentage of coaches however make use of professionals to obtain nutritional advice (Zinn et al., 2006:220; Juzwiak and Lopez, 2004:225; Torres-McGehee et al., 2012:208; Cockburn et al., 2014:1448; Couture et al., 2015:328; Salami et al., 2017:3). Among the professionals that are approached as reported in various studies, were physiotherapists, personal trainers, medical doctors, and dietitians/nutritionists. Coaches that approached registered dietitians and/or nutritionists found their services helpful and reported that their overall knowledge with regard to sports nutrition improved (Torres-McGehee et al., 2012:208).

It is evident that coaches are one of the main sources of information and play an influential role in an athlete's nutrition practices **(**Hoogenboom et al., 2009:147; Hornstorm et al., 2011:113; Walsh et al., 2011:369; Torres-McGehee et al., 2012:209; Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6).

Most coaches from the studies summarised in Table 2.1 did not have any formal nutrition training or education. Only 26.5 %, 25.2% and 41% of the coaches, in studies

by Salami et al. (2017:3), Cockburn et al. (2014: 1447) and Juzwiak and Ancona-Lopez (2004:224), respectively received formal nutrition training. Considering that many of these coaches acknowledged the importance of nutrition, the number of coaches that received nutrition training remains low (Juzwiak and Ancona-Lopez, 2004:224; Cockburn et al., 2014: 1445).

It is generally accepted and acknowledged that coaches will benefit from nutrition education programmes and educational tools to improve their knowledge and subsequently the advice they give to athletes (Jacob et al., 2016:1313).

2.3 NUTRITION KNOWLEDGE AND NUTRITIONAL PRACTICES OF ATHLETES

A limited number of studies focused specifically on adolescent (14 to 18 years) athletes' knowledge, behaviours and beliefs at school level, while more research is available for elite, club or collegiate level athletes. Table 2.2 provides a summary of several studies that investigated the nutrition practices, knowledge and attitudes of athletes and information sources they typically utilise. Some of these studies made use of similar questionnaires, while others developed specialised questionnaires.

Table 2.2: Summary of studies investigating the nutritional practices, knowledge and attitude of athletes in various sport types

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Manore et al. (2017) United States of America	**Sample size** 535. **Age/ Age range** 14 –18 years. **Gender** Male and female. (2017:2) **Method used** Questionnaires evaluating demographic, health history, sports nutrition knowledge. (2017:3)	High school soccer players. (2017:2)	**Practice** 55.7% eat breakfast daily (49.6% female players compared to 63% male players and 61.7% non-National School Lunch Program (NSLP) players compared to 47% NSLP players). 36.6% eat one hour before training/matches, 79.4% eat within one hour after training/matches. 46.4% used supplements (56.6% Latino players compared to 39.3% white players). 30.1% used of a protein shake or meal replacement beverage (More male players used protein shakes/beverages than female players and Latino players used protein shakes/meal replacements more than white players). Beverages consumed included water (preferred beverage) sport drinks, fruit juice drinks and diluted sports beverages. (2017:6) **Knowledge** Mean nutrition knowledge score: 45.6%. (2017:5) Female mean nutrition knowledge score: 45.1%. Male mean nutrition knowledge score: 46.1%. (No significant difference between nutrition knowledge and sex). (2017:6) > 76% of questions on hydration, 52% on supplementation, 35.5% on protein/carbohydrate and 24.3% pre/post exercise food selection were answered correctly. Significant difference between nutrition knowledge and race/ethnical group.	24% made use of dietary advice. Four of the top sources players utilized: Family/medical professional (12.7%), coach/trainer (12%), internet (10.3%) or friends (8.8%). (2017:6)	Attitudes and beliefs will influence athlete's nutritional practices for a life time. Thus, nutrition education will benefit adolescent athletes. Special attention and guidance should be placed on female athletes and ethnic groups. (2017:12)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
			(2017:5) **Attitude** 90.3% male and 85.5% female players believed diet is important for performance. 47.6% of players believed nutritional supplements were essential to support training demands (64.1% Latino players compared to 36% white players). 29.5% believed their diet met nutritional requirements (20.2% Latino players compared to 36.7% white players). 31% Latino players compared to 19% white players were unsure of what to eat. (2017:7)		
Alaunyte et al. (2015) England	**Sample size** 21. **Age/ Age range** 18 - 34 years. **Gender** Male. **Method used** Nutrition knowledge and food frequency questionnaire. (2015:2)	Rugby League players (2015:2).	**Practice** The "good nutrition knowledge (NK) group" consumed starchy foods, fruit and vegetables, oily fish and milk more frequently. The "poor nutrition knowledge (NK) group" consumed fizzy drinks and squash more frequently. Consumption of meat and poultry products, eggs, foods that are high in sugar and/or fat and other beverages were the same among the "good NK group" and the "poor NK group". The "good NK group" consumed significantly more vegetables compared to the "poor NK group". The "good NK group" consumed significantly more breakfast cereal, boiled/baked potatoes, meat casseroles/stews, peas/green beans, broccoli, cabbage and spring greens, cauliflower, peaches, nectarines and melons, strawberries, raspberries, mango and kiwi. (2015:3) **Knowledge** Mean nutrition knowledge score: 72.8%. Overall score in different nutrition knowledge categories:	N/A	Adequate nutrition knowledge observed did not translate into the appropriate dietary practice. Barriers of nutrition knowledge should be identified in elite athletes and coaches to figure out why nutrition knowledge does not translate into appropriate or better nutrition practices. (2015:6)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
			dietary advice (85.7%), food groups (71.2%), and food choice (69.5%). Mean nutrition knowledge score for "good NK group": 77.8%. Overall score in different nutrition knowledge categories: dietary advice (92.6%), food groups (76.3%) and food choice (73.6%). Mean nutrition knowledge score for "poor NK group": 67.4%. Overall score in different nutrition knowledge categories: dietary advice (78.2%), food groups (65.7%) and food choice (64%). Significant difference between "good NK group" and "poor NK group" and their overall scores. Significant difference between the "good NK group" and "poor NK group" and nutrition knowledge categories for food groups and dietary advice. No significant difference between the "good NK" and "poor NK" groups and nutrition knowledge categories for food choices. All in "poor NK group" and half of "good NK group" answered questions on starchy food consumption incorrect. (2015:3)		

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Devlin and Belski (2015) Australia	**Sample size** 46. **Age/ Age range** 23.5 ± 2.8 years. **Gender** Male. **Method used** Food and Nutrition knowledge questionnaire. (2015:226)	Elite Australian football league players. (2015:226)	**Knowledge** Mean nutrition knowledge score: 60.5%. Percentage correct scores: Sports nutrition knowledge (61.7%), sources of nutrients (60.9%), dietary recommendations (60%), choosing everyday foods (57%) and alcohol (53.3%). (2015:227) Good knowledge demonstrated on carbohydrate and protein content of foods and lacking knowledge on fat content of food. (2015:230) No statistically significant difference between total nutrition knowledge and age or years at elite level. Significant difference between total nutrition knowledge score and rating of the athlete's level of nutrition understanding, the perceived importance of adhering to a healthy diet and rating of their current dietary habits. (2015:229)	First source of information: dietitians. Secondary source of information: trainers and teammates. (2015:229)	Basic nutrition messages and recommendations seem to be well understood but gaps in nutrition knowledge were evident. Continuously assessing general and sports nutrition knowledge of athletes will help practitioners working with athletes. Reiterating the importance of dietitians within sporting clubs and the need for nutrition education interventions are needed. (2015:231)
Jürgensen et al. (2015) Brazil	**Sample size** 72. (2015:281) **Age/ Age range** Men:19.1 ± 4.4 years, Women: 17.3 ± 1.4 years. (2015:284) **Gender** Male and female. (2015:281) **Method used** Questionnaires	Team sports (male and female): basketball, indoor soccer, handball and volleyball. (2015:284)	**Practice** Men (45.7%) and women (51.4%) had inadequate diets. Men (45.7%) and women (56.8%) did not consume vegetables. Men (48.7%) and women (59.5%) did not consume whole fruits. Men (14.3%) and women (10.8%) met recommended intake of milk or dairy products. Whole grains consumed by three men and two women. Men consumed 71.9g of sugar and 100.3g of solid fat, and women consumed 67.0g sugar and 59.1g of solid fat. The recommendation for "meats, legumes and eggs" was	N/A	Athletes' dietary intake was inadequate. In order to identify food choices, investigation of factors influencing food behavior of athletes is needed. (2015:288)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
	evaluating nutritional knowledge. (2015:282) Dietary assessments. "Stage of intention to change eating behavior" questionnaire. (2015:283)		scored 56.8% by women and 68.6% men. (2015:284) Athletes used added sugar, simple carbohydrates in the form of supplements during or after training, made use of supplements (whey protein and BCAA and whey protein). Most of the men were pre-contemplation (28%) and maintenance stage (26%) of intention to change eating behavior. Women were mostly in the decision (25%) and action (25%) stages. (2015:285) **<u>Knowledge</u>** Mean nutrition knowledge score: 55.7% (men) and 57.4% (women). Mean correct score: Pre-training snack (98.6%), healthy eating (91.6%), balanced meal (90.3%), foods high in fats (88%), food groups (88%) and post-training snack (84.7%). Minimum percentage of correct answers: foods rich in vitamin C (27.2%). (2015:286)		

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Montecalbo and Cardenas (2015) Philippines	**Sample size** 85. **Age/ Age range** 16 - 24 years. **Gender** Male and female. **Method used** Dietary habits and nutritional knowledge questionnaire. (2015:46)	Athletic, arnis, badminton, baseball, basketball, beach volleyball, chess, dance sport, football, futsal, karate-do, pep squad, sepak takraw, swimming, softball, taekwondo, and volleyball. (2015:46)	**Practice** Median dietary score: 47. 54% have eaten their breakfast five to seven days per week. 8% of female athletes never ate their breakfast. 51% male and 50% female skipped meals once or twice a day per week. 3% male and 4% female athletes never skip a meal. (2015:47) No significant difference between dietary habits score of male and female athletes among different ages. (2015:48) Athletes with higher level of nutrition knowledge displayed better dietary habits. (2015:49) **Knowledge** Median nutrition knowledge score: 89. Male knowledge level: 0% poor, 67% fair, 15% good, 18% excellent. Female knowledge level: 4% poor, 63% fair, 15% good, 18% excellent. (2015:47) No significant difference between nutrition knowledge scores of male and female athletes among different ages. (2015:48) Athletes who had a higher level of nutrition knowledge also had significantly better dietary habits. (2015:49)	Three major information sources used by athletes: parents (39%), coach (21%) athletic trainer (18%). Other sources: TV (13%), magazines (4%), friends (2%), nutrition subjects (1%) and internet (1%). (2015:46)	Parents, coaches, and athletic trainers are the primary sources of nutrition information utilized by athletes. Hence, it's important that they are well-informed to give reliable information and advice. For nutritional advice nutrition experts should be used more often. Ongoing nutrition training and education programmes should be delivered on a regular basis. (2015:49)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Webb and Beckford (2014) Trinidad and Tobago	**Sample size** 220 **Age/ Age range** 11- 21 years. (2014:2) **Gender** Male and female. (2014:3) **Method used** Questionnaire evaluating nutrition knowledge and attitudes. (2014:2)	Swimmers. (2014:2)	**Practice** 56.8% of the swimmers never attended any nutrition class/course/seminar and 53.2% never attended nutrition class/course/seminar over the last year. (2014:3) **Knowledge** Mean nutrition knowledge score overall 10.97 ± 2.90. Male (11.05 ± 2.793) and female (10.88 ± 3.033). No significant differences between genders, age and highest level education. Significant difference in nutrition knowledge score between categories for number of classes attended; more classes attended the higher nutrition knowledge score. Nutrition knowledge significantly related to attitude. (2014:3) Nutrition areas lacking: the role of protein in the body, the characteristics of carbohydrates, the role of micronutrients in the body (especially iron), types of fats and proper energy sources from food. (2014:4) **Attitudes** Mean attitude score for attitude towards nutrition was 41.69 ± 6.215. Overall positive attitude towards nutrition. Male respondents' mean positive attitude score towards nutrition was higher compared to females' score. No significant differences in the attitude towards nutrition scores between the means for gender, age, level of education, number of nutrition classes attended since beginning to swim. (2014:4)	N/A	Positive attitude towards nutrition was displayed, although nutrition knowledge was inadequate. Athletes will have an interest for education with regards to nutrition. Intervention programmes will be beneficial for swimmers and other athletes. (2014:6)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Shriver et al. (2013) United States of America	**Sample size** 52 **Gender** Female. **Method used** Dietary assessment and nutrition questionnaire. (2013:12)	Collegiate athletes from National Collegiate Athletic Association (NCAA) Division I university. Soccer, basketball, cross-country runners, and track and field athletes. (2013:12)	**Practice** Energy intake of the participants was 1,939 kcal or 30kcal/kg. (53% of TE came from carbohydrates, 16% from protein and 31% from fat). 91% did not meet energy needs. 74% failed to meet carbohydrate recommendations and 50% failed to meet the protein recommendations. 36% of the athletes consumed less than five meals/snacks a day. 9% of the athletes consumed less than three meals a day. 27% of the athletes consumed less than two snacks a day. 27% of the athletes consumed regular breakfast. Dinning out 5.4 times per week. Hydration statuses were being monitored on a regular basis by 16% of the athletes. 44% of the athletes assessed their diet as "good," and 56% as "fair" or "poor." 33% of the athletes had the desire to lose weight. (2013:13)	N/A	The female athletes failed to meet their minimum energy and carbohydrate needs and follow basic sports nutrition guidelines. Improvement of sports nutrition knowledge among female college athletes is needed, in order to improve nutrition practices. (2013:15)
Arazi and Hosseini (2012) Iran	**Sample size** 250. **Gender** Male and female. **Method used** Questionnaire evaluating nutritional knowledge and food habits. (2012:102)	Collegiate and non-collegiate athletes. (2012:102)	**Knowledge** Mean score for collegiate male athletes were 52.5% and collegiate female athletes were 54.9%. Mean score for non-collegiate male athletes was 39.9% and non-collegiate female athletes was 40.7%. There is a significant difference in nutrition knowledge between collegiate athletes and non-collegiate athletes. (2012:103) Collegiate athletes' percentage correct response on carbohydrates, fat, protein, fiber, vitamins, calcium and iron group was higher than non- collegiate athletes. Significant difference between collegiate male and collegiate female athletes' nutrition knowledge. No significant difference between non-collegiate male and non-collegiate female athletes' nutrition knowledge. Percentage correct response was significantly higher in collegiate athletes compared to non-collegiate athletes.	N/A	Knowledge and attitude of non-collegiate athletes need to improve. Improved nutrition education programmes may be an effective way to promote nutrition knowledge and attitudes of non-collegiate athlete. (2012:105)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
			(2012:102) **Attitudes** Nutrition attitude scores of collegiate female/male athletes are significantly higher than in non-collegiate female/male athletes. (2012:104)		
Davar (2012) India	**Sample size** 30. **Age/ Age range** 17- 23 years. **Gender** Female. **Method used** Questionnaire evaluating nutritional knowledge and attitude. (2012:120)	College hockey players. (2012:120)	**Practice** Family food habits, beliefs and culture influences athletes. Little participated in any nutrition education. (2012:122) **Knowledge** Mean nutrition knowledge score: 38.8%. Percentage correct answers: Hydration (51.6%), fats (53.5%), functional foods (43.8%), minerals (43.8%), protein (41.1%), vitamins (39.3%), carbohydrates (37.7%), sports nutrition (36.5%), weight management (32.2%), energy (25.9%) and fiber (21.4%). (2012:121) **Attitude** Total positive responses: 90.6%. 93.3% believed learning facts about nutrition would be beneficial to achieve positive changes in food habits. (2012:122)	Family members (43.3%), magazines/newspapers/ books (26.6%), TV/radio (26.6%), teammates (23.3%), coaches (13.3%) and dietitian (0%). (2012:121)	Female athletes lack knowledge and are unable to make good food choices. They are influenced by trainers, family and peers or, eat whatever is given to them. It is revealed that physical appearance and weight control issues are some of the reasons affecting food selection. Nutrition education is important and needs to be integrated as part of curriculum (2012:123)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Spendlove et al. (2012) Australia	**Sample size** 334. **Age/ Age range** The average age for elite Australian athletes was 18.9 years, community sample was 21.9 years and for dietetic-trained cohort was 29.1 years. **Gender** Male and female. (2012:1874) **Method used** Questionnaire evaluating general nutrition knowledge. (2012:1872)	Elite Australian athletes (EA), community (CM) sample and dietetic-trained (DT) cohort. (2012:1872)	**Knowledge** Mean nutrition knowledge score for EA (57.6%), CM sample (63.1%) and DT cohort (86.2%). EA and CM sample scored significantly less than the DT cohort. Between EA and CM samples there was no significant difference. (2012:1875)	N/A	Knowledge did not translate into adequate practices and knowledge needs to be improved. (2012:1879)
Torres-McGehee et al. (2012) United States of America	**Sample size** 579. **Gender** Male and female. **Method used** Demographic and sports nutrition questionnaire. (2012:206)	National Collegiate Athletic Association Division I, II, and III: Baseball, basketball cheerleading, dance, equestrian, football, golf, ice hockey lacrosse, soccer, swimming and diving, tennis, track and field, volleyball, and wrestling. (2012:206)	**Practice** 43% of athletes refer to their coaches for advice. (2012:207) **Knowledge** Overall average 68.5% in all domains. Adequate knowledge was demonstrated in 35.9% of the coaches, 71.4% of athletic trainers, 83.1% of the strength and conditioning specialists, and 9% of the athletes. (2012:210) **Attitude** Athletes believed that they understood the importance of following a healthy diet and fairly well understood the value of an athlete's nutritional needs.	The most used nutrition resources for coaches, athletic trainers, strength and conditioning specialists were registered dietitians. (2012:208)	Athletic trainers and strength and conditioning specialists had adequate sports nutrition knowledge. Coaches and athletes displayed inadequate knowledge. Nutrition education programmes should be implemented and should include coaches and athletes.

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
			(2012:211)		(2012:211)
Sangeetha et al. (2014) India	**Sample size** 100. **Gender** Male and female. **Method used** Nutritional profile and dietary assessment. Nutrition education programme. (2012:971)	Sport persons from athletic events, group events, cricket, football, hockey, kho-kho kabady, handball, basketball, volleyball. (2012:971)	**Practice** 80% non-vegetarians, 15% vegetarians and the rest of were ovo-vegetarian. 52 % of sportspersons took two meals/day, 25% three meals/day, 8% more than three meals/day, 10% two meals/day with snacks, 5% three meals/day with snack. 65% habit of skipping meals. (2012:972) The mean intake of all nutrients was less than the recommended dietary allowance. (2012:973) **Knowledge** Significant difference in the nutrition knowledge before and after education. (2012:974)	N/A	Poor nutrition knowledge reflected in their nutrient intake. Nutrition education created awareness amongst sportspersons. In the long run this can help improve their nutritional status. Significant improvement after educational programme. (2012:977)
Valliant et al. (2012) United States of America	**Sample size** 11. **Gender** Female. **Method used** Sports nutrition questionnaire, dietary assessment and nutrition education programme. (2012:508)	NCAA Division 1 volleyball. (2012:508)	**Practice** Failed to meet energy, carbohydrate, protein and fat recommendations over the two seasons. Significant improvement in energy, carbohydrate and protein intake after intervention. **Knowledge** Mean nutrition knowledge score significantly improved after intervention. (2012:510)	Media/Internet/coaches/trainers. (2012:513)	Nutrition education was useful in improving dietary intake and improving knowledge among athletes. (2012:514)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Hornstrom et al. (2011) United States of America	**Sample size** 185. **Gender** Female. **Method used** Sports nutrition questionnaire. (2011:112)	College softball players. (2011:112)	**Practice** Mean nutrition choice score: 19.4 ± 3.8. Mean nutrition practice score: 2.8 ± 1.3. (2011:112) Significant difference between nutrition choice and nutrition practice score. (2011:113) **Knowledge** Mean nutrition knowledge score: 45.7 ± 4.7. (2011:112) 65% failed the test. (2011:113) A significant relationship between players' nutrition knowledge and nutrition practices. (2011:112) Significant relationship between players' nutrition knowledge and attitude toward a sport-enhancing diet. (2011:113) Athletes who had received nutrition education had higher knowledge. (2011:114) **Attitude** Mean attitude score toward a sport-enhancing diet score was 1.9 ± 0.4. (2011:112) Significant positive connection between the players' attitude toward a sport-enhancing diet score and their nutrition choice score; indicating that players with positive attitude have a healthier eating habit. No connection between sport-enhancing diet score and their nutrition practice score. Showing that players' attitude is not	22% never consulted a dietitian before. (2011:112) The preferred sources: Physicians (1.6 ± 0.7), followed by athletic trainers (1.8 ± 0.8), a college nutrition or health course (1.9 ± 0.8), or a dietitian (1.9 ± 1.0). Coaches (2.5 ± 0.9) and academic journals (2.9 ± 0.9) were least likely used. (2011:113)	A positive attitude was displayed but lack of adequate knowledge and good practice existed. Majority of the players believed it would be beneficial to learn more about sport performance and nutrition. Athletes should be encouraged to seek accurate nutrition advice from dietitians. (2011:115)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
			associated to their nutrition practice. (2011:113)		
Walsh et al. (2011) Ireland	**Sample size** 203. **Age/ Age range** 15-18 years. **Gender** Male. **Method used** Body composition measurement and knowledge questionnaire. (2011:367)	Senior schoolboy rugby players. (2011:367)	**Practice** Inconsistency between knowledge and practices were identified. **Knowledge** Mean nutrition knowledge score: 59.6%. Mean nutrition knowledge score on hydration (76.4%), dietary supplements (69.2%), energy and refueling (57.1%) and protein (39.2%). No significant difference between nutrition knowledge and age, player's body fat percentage, or position. (2011:367) **Attitude** 40% of players believed that their sport performance could be improved by following a diet. 37.4% did not know what to eat. 6.4% of players indicated pressure from teammates, coaches, and others to follow a specific diet or to use dietary supplements. 46.8% indicated that supplements are important to support their training programme. 84.7% believed in order to improve rugby performance they have to increase muscle mass. (2011:368) 97% of players agreed that they can benefit from nutritional education (2011:369)	59.6% made use of dietary advice (66.9% of made use of coaches for advice, and 35.5% teammates). 8.2% approached health care professionals (dietitians, nutritionist, physiotherapist and dermatologist) for nutritional information. 93% of those 115 players who had been given nutrition advice, reported finding the advice useful. 66.9% indicated coaches as the primary source of nutritional information. (2011:369)	Lack of nutrition knowledge and poor practices was demonstrated. (2011:370) It is important to increase nutritional information, education and awareness among these players. 70.7% of players indicated that information leaflets would be a useful information source. (2011:372)

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
Azizi et al. (2010) Iran	**Sample size** 598. **Gender** Male and female. **Method used** Nutrition knowledge and attitude questionnaire. (2010:107)	Elite college athletes. (2010:107)	**Knowledge** Mean nutrition knowledge score males (57.3%) and females (60.4%). (2010:107) Mean nutrition knowledge score for different majors in females: Physical science (61.8%), engineering (58.6%), literature (58.3%), science (57.7%) and agriculture (57.7%). Mean nutrition knowledge score for different majors in males: Literature (57.8%), agriculture (57.7%), science (57.6%), physical education (57.3%) and engineering (57.1%). (2010:108) Between female and male college athletes there was a significant difference between nutrition knowledge and attitude. Significant positive correlation between nutrition knowledge and attitude among males and females. (2010:109) **Attitude** Mean nutrition attitude score for different majors in females: Physical education (58.2%), science (57.6%), engineering (55.79%), literature (55.5%) and agriculture (55.4%). Mean nutrition attitude score for different majors in males: Physical education (56.6%), engineering (55.7%), science (54.8%), agriculture (54.4%), literature (54.1%). (2010:108)	N/A	Athletes' nutrition knowledge are moderate and both nutrition knowledge and nutrition attitude need improvement. The importance of nutrition in college learning environment needs emphasis. (2010:110)
Hoogenboom et al. (2009) United States of	**Sample size** 85. **Gender** Female. **Method used**	College swimmers. (2009:141)	**Practice** Mean caloric intake for all of the female collegiate swimmers was 3229.10 kcal.	Athletic trainers, books, coach, community education courses, dietician, doctor, fitness classes, friends, health food store, high school, internet, magazines,	Fair nutrition knowledge was demonstrated, while a lack of application of knowledge to their current dietary habits

Study and Country	Sample Size, Age/Age range, Gender and Method Used	Sporting Code/Level	Nutrition Practice, Knowledge and Attitude	Source of Information	Conclusion
America	Nutrition knowledge questionnaire and dietary assessment. (2009:141)		56.7% met the recommended dietary allowance (RDA) for calcium of 1200mg. (2009:143) 80% met the RDA for iron intake for women ages 19 - 24 years old. 52.9% met the female RDA for zinc. 90.6% failed to meet at least one of the RDA ranges for proteins, carbohydrates, or fats. 80% of the athletes did not meet two of the three RDA ranges for macronutrients. 84.7% did not fall within the RDA range for carbohydrates, 52.9% of the athletes did not fall within the RDA range for protein. 62.7% of did not fall within the RDA range for dietary fat intake. **Knowledge** Mean percentage for nutrition knowledge:71.8%. (2009:144)	newspaper, radio, parents, teammates, university courses, or other sources. (2009:144)	was demonstrated. (2009:147)

N/A – NOT APPLICABLE

2.3.1 NUTRITION KNOWLEDGE OF ATHLETES

Studies summarised in Table 2.2 are consistent in their findings that athletes' nutrition knowledge is poor. Lack of knowledge was not only prevalent among high school athletes (Walsh et al., 2011:367; Manore et al., 2017:20), but also among collegiate/university students (Hoogenboom et al., 2009:144; Hornstrom et al., 2011:112; Arazi and Hosseini, 2012:102; Torres-McGehee et al., 2012:206; Shriver et al., 2013:12; Montecalbo and Cardenas, 2015:46) and elite athletes (Azizi et al., 2010:107; Spendlove et al., 2012:1872; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226).

A recent study among high school athletes by Manore et al. (2017:1) investigated male and female soccer players' nutrition knowledge, behaviours and beliefs and whether there is a difference in variables between gender, race/ethnic groups or socioeconomic status. The study reported that soccer players achieved a lower nutrition knowledge score (45.6%) than what rugby players achieved (59.6%) in a similar study by Walsh et al. (2011:367). Although there is about a 14% difference between nutrition knowledge scores in the two studies, it is worth noting that male and female athletes where included in the study of Manore et al. (2017:2), whereas, Walsh et al. (2011:366) included only male and possibly more elite rugby players.

The lowest mean nutrition knowledge score was observed in a study by Davar (2012:120) that investigated the nutrition knowledge and attitudes towards healthy eating of collegiate level hockey players. The hockey players displayed a low level of nutrition knowledge, with a mean nutrition knowledge score of 38.8%. The highest mean nutrition knowledge score of 72.8% was reported for elite English rugby league players (Alaunyte et al., 2015:1).

Webb and Beckford (2014:3) investigated the nutrition knowledge and attitudes of adolescent swimmers, training competitively in Trinidad and Tobago and concluded that the swimmers' knowledge was insufficient. Torres-McGehee et al. (2012:210) examined nutrition knowledge in four domains (athletes, coaches, athletic trainers, and conditioning specialists) of various sports and reported that athletes had inadequate nutrition knowledge scores of less than 75%. In the study by Hornstrom et al. (2011:112) the nutrition knowledge, practices, attitudes, and information sources of 185 Mid-American Conference College female softball players were determined.

The mean nutrition knowledge score was reported to be low (45.7%). A standard cut off point of 60% was used to set a failing mark and therefore 65% of female softball players failed the nutrition knowledge test (Hornstrom et al., 2011:112).

A variety of resources are often available to athletes competing at an elite level. Often dietitians form part of a high performance programme, a club or a franchise, making access to the services of dietitians or nutritionists accessible (Devlin and Belski, 2015: 230). Other possible reasons why elite athletes may have a better understanding of nutrition is because they have a higher interest in nutrition as a means to improve their performance. Younger athletes, who are less elite, may have less exposure to nutrition education or information or are still learning the skills of their sport and have less interest in sports nutrition, nutrition education or information (Manore et al., 2017:9). Irrespective of the fact that elite athletes possibly understand nutrition messages better, research shows that there is still a clear lack of knowledge observed (Alaunyte et al., 2015:3; Devlin and Belski, 2015:230).

Various studies measured factors influencing the level of nutrition knowledge among athletes. Some of these factors include: age (Webb and Beckford, 2014:3; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:47), race/ethnic groups (Spendlove et al., 2012:1879; Manore et al., 2017:7), level of education and field of study (Azizi et al., 2010:108; Hornstrom et al., 2011:112; Arazi and Hosseini, 2012: 104; Spendlove et al., 2012:1875; Webb and Beckford, 2014:3), gender (Azizi et al., 2010:107; Arazi and Hosseini, 2012:103; Webb and Beckford, 2014:3; Montecalbo and Cardenas, 2015:47; Jürgensen et al., 2015:286; Manore et al., 2017:4) and athletes versus non-athletes (Ozdoğan and Ozcelik, 2011:2; Spendlove et al., 2012:1875).

Webb and Beckford (2014:3) found that younger athletes have a tendency to score lower than older athletes. Athletes between the ages of 11 to 12 years scored lower than athletes in the age range of 18 to 21 years, suggesting nutrition knowledge increased as age increased, but this finding was not statistically significant**.** These findings were similar in two other studies where no link between knowledge and age were found (Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:47).

Nutrition knowledge among athletes from different race/ethnic groups was only

measured by two studies in Table 2.2. The results in the study by Spendlove et al. (2012:1879) did not show any differences in general nutrition knowledge based on race/ethnic groups. Manore et al. (2017:7) however reported that Latino athletes had significantly lower nutrition knowledge scores compared to white athletes in their study.

Athletes' nutrition knowledge seems to be influenced by their level of nutrition education background. As can be expected, a higher nutrition knowledge score was reported in athletes that were exposed to nutrition education (Hornstrom et al., 2011:112). This finding was supported by Arazi and Hosseini (2012:104) and Spendlove et al. (2012:1875) who found that collegiate female and male athletes scored significantly higher than non-collegiate female and male athletes (Arazi and Hosseini, 2012:104), while Australian elite athletes scored significantly lower than the dietetic-trained cohort (Spendlove et al., 2012:1875).

Azizi et al. (2010:108) suggested that nutrition knowledge was related to athletes' majors and that results varied in terms of their level of knowledge, depending on the field of their studies. Although further investigation is needed to determine the link between courses and nutrition knowledge, it was clear that majors like "Physical education" requires the completion of physiology, sports nutrition and exercise science courses. Thus, the nutrition background of these subjects may have led to better performance in the nutrition knowledge test for athletes enrolled in health related majors (Azizi et al., 2010:110).

Although Webb and Beckford (2014:3) found no significant difference between knowledge and highest level of education, a link between nutrition knowledge scores and the number of nutrition classes attended was identified. Nutrition education may therefore be beneficial; and providing nutrition courses to non-physical education college students or athletes, could help increase their nutrition knowledge and have a positive influence on dietary choices (Azizi et al., 2010:110; Webb and Beckford, 2014:3).

Gender differences in nutrition knowledge have been investigated in several studies. Montecalbo and Cardenas (2015:47) as well as Webb and Beckford (2014:3) reported that nutrition knowledge is not related to gender. Some studies reported female

athletes to have a significantly higher nutrition knowledge compared to male athletes (Azizi et al., 2010:107; Arazi and Hosseini, 2012:102; Jürgensen et al., 2015:286), while another reported males to have a better nutrition knowledge (Manore et al., 2017:4).

The tendency for athletes to have better nutrition knowledge than non-athletes was not observed in any of the studies summarised in Table 2.2. In one study, the mean nutrition knowledge score of athletes was reported to be lower than non-athletes (Spendlove et al., 2012:1875). Overall, the nutrition knowledge of athletes and their non-athlete counterparts does not seem to be different (Ozdoğan and Ozcelik, 2011:2).

The common misconceptions observed in studies reviewed in Table 2.2 included dietary roles of protein, carbohydrates (Walsh et al., 2011:367; Davar, 2012:121; Torres-McGehee et al., 2012:210; Webb and Beckford, 2014:4; Alaunyte et al., 2015:3; Manore et al., 2017:5) and fat (Davar, 2012:121; Webb and Beckford, 2014:4; Devlin and Belski, 2015:226), vitamin and minerals (Davar, 2012:121; Webb and Beckford, 2014:4).

The questions answered worst by high school soccer players and rugby players was on protein intake, with a mean score of 35.5% and 39.2%, for the two groups respectively (Walsh et al., 2011:367; Manore et al., 2017:5). Overall, 36.0% of rugby players correctly indicated that “muscles do not get most of their energy from protein”, 39.4% indicated that “additional protein consumed may be stored as fat” and 38.4% believed “in order to build more muscle, the more protein you need to eat” (Walsh et al., 2011:367).

Webb and Beckford (2014:4) studied the nutrition knowledge and attitudes of adolescent male and female swimmers in Trinidad and Tobago and reported that 50% of the 220 participants did not display sufficient knowledge when they were asked about protein’s role in the body, the characteristics of carbohydrates, the role of micronutrients in the body, types of fats, and about energy sources from food.

Alaunyte et al. (2015:5) and Davar (2012:121) suggested that knowledge about carbohydrates is one of the areas that needs attention and improvement, as it was a topic where knowledge was lacking amongst participants in their respective studies.

Athletes are generally unaware of the latest carbohydrate recommendations (Alaunyte et al., 2015:3). Webb and Beckford (2014:4) found that only 46.4% of athletes correctly answered the statement "carbohydrates are stored in muscles in the form of glycogen", in their study.

Athletes appear to be fairly knowledgeable about the role of fat in the diet, but they are not well informed about the different types of fat (Davar, 2012:121; Webb and Beckford, 2014:4, Devlin and Belski, 2015:227).

An area that seems to be well understood is hydration. A study by Walsh et al. (2011:367) found that 97% of high school rugby players correctly indicated that dehydration can decrease performance and 39.4% were aware that sports drinks should be used as hydration fluid during exercise lasting longer than one hour.

2.3.2 NUTRITIONAL PRACTICES OF ATHLETES

Despite the fact that general healthy eating guidelines and international sports nutrition recommendations are available (ADA/DC/ACSM, 2016:501), inadequate dietary practices are still common among athletes (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Sangeetha et al., 2014:973; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Valliant et al., 2012:510; Shriver et al., 2013:13; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20).

Many reasons as to why good practices are not followed exist. Poor nutrition knowledge, inadequate information sources, attitude towards nutrition, family/social influences and encountered barriers (lack of money, time, taste, availability, accessibility and culture) are all factors influencing and determining food choices (Davar, 2012:123). In addition to a lack of knowledge, the relationship between knowing and doing is not always demonstrated. Athletes might have a higher level of nutrition knowledge, which can lead to better nutritional practices (Montecalbo and Cardenas, 2015:49). However, this higher level of nutrition knowledge does not always lead to improved nutritional practices (Hoogenboom et al., 2009:145; Walsh et al., 2011:368; Webb and Beckford, 2014:6; Alaunyte et al,. 2015:3; Devlin and Belski, 2015:226).

Walsh et al. (2011:367) reported that only 113 of 168 (67.7%) high school rugby players, who knew they should eat within half an hour after exercise, actually did so. Also, 35 of the 163 (21.6%) who knew that taking mineral and vitamin supplements is unnecessary, still made use of such supplements while 109 out of 171 (63.7%) were aware that claims made on dietary supplements are not always trustworthy, but were taking supplements.

Hoogenboom et al. (2009:145) investigated the nutrition knowledge of female collegiate swimmers. The swimmers demonstrated fair knowledge when it came to nutrition, yet 90.6% of the swimmers still did not meet the recommended dietary allowance (RDA) for the macronutrients.

A clear difference exists between declarative knowledge ("*knowledge of nutrition facts*") and procedural knowledge ("*knowledge exercised in the performance of some task*") (Davar, 2012:121; Alaunyte et al,. 2015:6; Devlin and Belski, 2015:226). If declarative knowledge was shown to be adequate and procedural knowledge poor, it was unlikely that nutrition knowledge would translate into healthier food choices and better nutritional practices (Hoogenboom et al., 2009:145; Alaunyte et al,. 2015:6).

Nutritional practices of athletes can be determined by athletes' attitudes (Hornstrom et al., 2011:112; Montecalbo and Cardenas, 2015:47; Manore et al., 2017:5). Athletes who felt more confident with their level of nutrition knowledge also felt that they have a greater ability to develop better nutrition habits (Manore et al., 2017:5). However, other studies reported that nutrition knowledge and attitudes had no impact on the nutritional practices of athletes (Hornstrom et al. 2011:112; Alaunyte et al. 2015:5; Hoogenboom et al. 2009:145).

In addition to the mentioned barriers, athletes also often make use of unreliable sources of information, which contributes to the problem of making poor food choices (Hornstorm et al., 2011:113; Walsh et al., 2011:369; Davar, 2012:121; Torres-McGehee et al., 2012:209; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6).

A study on the nutrition knowledge of female college hockey players and how well they apply their nutrition knowledge to their everyday dietary choices, reported that very

few hockey players reported to seek nutritional information or participated in any nutrition education. Nutrition information was obtained from parents (43.3%), magazines and television (26.6%), teammates (23.3%) and coaches (13.3%), while no one made use of a dietitian (Davar, 2012:121). These findings were similar to a study by Manore et al. (2017:6) where only 24% of soccer players reported seeking sports nutrition information from an expert. These athletes' primary sources of information were reported to be coaches (12%), family/medical professionals (12.7%), the internet (10.3%) and friends/peers (8.8%).

Coaches serve as an important source of information for athletes, and although it has been shown that they often have misinformed beliefs and lack nutrition knowledge, athletes would rather rely on coaches for advice (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328; Salami et al., 2017:4). Often dietitians are not available to athletes or athletes feel more comfortable to obtain nutrition advice from coaches. This might be due to the important position they take up in a team environment, the relationships developed through everyday contact and the responsibilities these people have towards the overall well-being of the athlete (Torres-McGehee et al., 2012:207).

Few athletes therefore make use of a dietitian for nutrition information (Hornstrom et al., 2011:113; Torres-McGehee et al., 2012:209; Walsh et al., 2011:369; Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6) which might assist in improving their athletic performance. A dietitian conducts a comprehensive nutrition assessment and guides athletes on the optimal nutrition goals for their specific training schedule and overall health. Dietitians are able to assist athletes with regard to determining nutrient requirements for exercise training, recovery from exercise, hydration, competition and weight management (Torres-McGehee et al., 2012:207), while they also help to address nutrition challenges like cultural influences, lack of time, financial limitations, cooking skills and the sport environment (Davar, 2012:122; Jürgensen et al., 2015:287).

It is clear that nutritional practices among athletes are not always according to recommended established guidelines (ADA/DC/ACSM, 2016:501). Insufficient energy and carbohydrate intake (Hoogenboom et al., 2009:144; Sangeetha et al.,

2014:973; Valliant et al., 2012:510; Shriver et al., 2013:13), micronutrient insufficiencies (Hoogenboom et al., 2009:143; Sangeetha et al., 2014:973), skipping meals (Hoogenboom et al., 2009:145; Sangeetha et al., 2014:972; Valliant et al., 2012:513; Shriver et al., 2013:13), supplement use (Walsh et al., 2011:367; Sangeetha et al., 2014:974; Jürgensen et al., 2015:285; Manore et al., 2017:6) and inadequate nutrient timing (Davar, 2012:122; Walsh et al., 2011:367; Manore et al., 2017:6) are some of the poor practices observed amongst athletes.

Shriver et al. (2013:13) evaluated the dietary intake and eating habits of female collegiate athletes and Valliant et al. (2012:510) investigated the energy and macronutrient intake of a female volleyball team over two off-seasons. Both studies reported that female athletes failed to meet the energy recommendation of 37 to 41 kcal/kg body weight. Similar results were found in the study of Hoogenboom et al (2009:143) and the study of Sangeetha et al. (2014:973) who investigated nutritional status, knowledge and impact of nutrition education among athletes in the Coimbatore District.

Athletes who follow an energy deficient diet during training often experience significant weight loss (including muscle mass), illness, onset of physical and psychological symptoms of overtraining, and a reduction in performance (ADA/DC/ACSM, 2016:505). In females, a negative energy balance can lead to disturbed eating patterns, menstrual disorders and low bone mineral density, which is referred to as the female athlete triad syndrome (ADA/DC/ACSM, 2016:505; Bean 2017:212). Therefore, it is crucial to ensure that athletes are well nourished and consume enough energy to balance the increased energy demands of training and maintaining body weight (ADA/DC/ACSM, 2016:504).

Different foods contain different amounts of carbohydrates, protein and fats and when these nutrients are broken down in the body, a certain amount of energy is provided (Bean, 2017:17). Specific macronutrient requirements should be based on an individual's body size, age, gender, activity level and type of sport (Cotugna, 2005:324).

Various studies found that the intake of carbohydrates was low among athletes (Hoogenboom et al., 2009:144; Sangeetha et al., 2014:973; Valliant et al., 2012:510;

Shriver et al., 2013:13). Even after the intervention, consisting of individualised dietary education once every month for 4 months took place, the athletes' carbohydrate intake was still below the recommended intake of 6 to 10 g/kg body weight (Valliant et al., 2012:510; Shriver et al., 2013:13). Female collegiate swimmers (72.9%) are reported to consume less carbohydrates than the recommend daily allowance (Hoogenboom et al., 2009:144) which is also reported for 17% of athletes in the study of Sangeetha et al. (2014:973) and 74% of female collegiate athletes in the study of Shriver et al. (2013:13).

Insufficient carbohydrate intake can lead to depletion of glycogen stores in the muscles and liver, which lead to a quicker onset of fatigue and thus reduced work rates as well as impaired skill and concentration levels (ADA/DC/ACSM, 2016:508; Bean, 2017:33).

An increased intake of high fat foods in the place of carbohydrate rich foods can be the reason for athletes failing to meet the recommended carbohydrate intake (Hoogenboom et al., 2009:144; Valliant et al., 2012:510; Shriver et al., 2013:13). After Shriver et al. (2013:13) evaluated the dietary intake and eating habits of female college athletes, they found that 24% of female athletes reported a fat intake of above 35% of total energy, which is above the recommended range of 20% to 35% of total energy (Bean, 2017:184).

Although fat is a good source of energy, it has not been shown that high fat diets are beneficial to sport performance, especially when intake compromises carbohydrate intake. Thus, it is recommended that athletes increase their carbohydrate intake and reduce their fat intake in order to have a balanced macronutrient distribution and meet carbohydrate intake recommendations (Valliant et al., 2012:512).

The International Society for Sport Nutrition's (ISSN) recommendations for fat intake is almost similar for athletes than for non-athletes, in order to promote health (Cotugna, 2005:324). Fat plays a role in the body by protecting organs, helping fat-soluble vitamin uptake and providing essential fatty acids while also playing an important role in energy production (ADA/DC/ACSM, 2016:511).

Thus, the balance of macronutrients (carbohydrate, protein and fat) in an athlete's diet is an important component to optimising training and performance (ADA/DC/ACSM, 2016:507).

Insufficient intake of micronutrients, especially calcium (Hoogenboom et al., 2009:143; Sangeetha et al., 2014:973) and iron (Sangeetha et al., 2014:973) was observed among athletes. An adequate calcium intake is essential for strong, heathy bones and is needed for muscle contraction and relaxation, blood clotting and neuro transmission (Bean, 2017:99). Iron plays an essential role in the formation of haemoglobin and myoglobin. A deficiency in iron can lead to anaemia, thereby affecting performance (Bean, 2017:100). Athletes who consume adequate amounts of energy and follow a healthy, balanced diet, can meet their micronutrient requirements with ease. Most athletes eat more than the average person and thus, with the right food choices, the higher vitamin and mineral needs can be met (Bean, 2017:95).

Skipping meals are common amongst athletes (Hoogenboom et al., 2009:145; Sangeetha et al., 2014:972; Valliant et al., 2012:513; Shriver et al., 2013:13). Out of all the female athletes in the study by Valliant et al. (2012:513), 72.7% skipped meals, which was similar in the study by Sangeetha et al. (2014:972) with 65% of athletes skipping meals. Often athletes consume food only three times per day (Shriver et al., 2013:13). Skipping meals may have contributed to low energy intakes and can thus lower training potential and have other health risks (Shriver et al., 2013:13).

Female collegiate athletes in the study by Shriver et al. (2013:13), and female volleyball players in the study of Valliant et al. (2012:513), indicated that they have a desire to lose weight. Reasons for restricting energy intake lower than recommended could be due to pressure from society, the image of an ideal body, and weight restricting behaviours (Hoogenboom et al., 2009:145) as well as barriers like class schedules, work, practice, studying and the influence of family and friends (Valliant et al., 2012:513).

Athletes had similar practices in terms of consumption of food before a training session or game in both the studies by Manore et al. (2017:6) and Walsh et al. (2011:367), with 36.6% and 26.6% consuming food before a training session or game, respectively. In the study by Davar (2012:122), the majority (73.3%) of female athletes were unable to identify that a pre-match meal should be eaten three to four hours before an event in order to allow optimal digestion and a steady energy supply. Walsh et al. (2011:367) further reported that 61.6% of athletes consumed food within half an hour after training or game, while 79.9% of athletes in a study by Manore et al. (2017:6)

consumed food within one hour after training or a game. In both studies, athletes consumed a high-carbohydrate or high-protein food after training or game (Walsh et al., 2011:367; Manore et al., 2017:6).

The perception of carbohydrates being unhealthy and/or the promotion of high-protein low-carbohydrate diets by the media may have caused uncertainty about the role of carbohydrate-rich foods (Spendlove et al., 2012:1875) in athletic performance.

In order to optimise carbohydrate availability, the amount and type of carbohydrates ingested prior to, during, and following intense exercise are important to consider (Kreider, 2010:8). Carbohydrate intake prior to training should be 1 - 4 g/kg body weight and should be consumed two to four hours before exercise (Bean, 2017:58). The recommendation for carbohydrate intake during exercise is 30-60g per hour. To promote recovery after exercise, 1.0 to 1.5 g of carbohydrates per kilogram body weight per hour within 30 minutes after exercise and then every 2 hours for up to 6 hours are recommended. High and moderate glycaemic index carbohydrates are recommended as the better choice to consume during exercise and will also promote faster recovery after exercise (Bean 2017:63).

Nutrition supplements are often used by athletes (Walsh et al., 2011:367; Jürgensen et al., 2015:285; Manore et al., 2017:6). Athletes mostly use protein shakes or meal replacement beverages, creatine supplements and vitamin and mineral supplements. It is concerning that 16.8% and 42.3% of the 149 athletes that made use of creatine and protein supplements respectively in the study by Walsh et al. (2011:367) were younger than 18 years. The large number of athletes that made use of dietary supplements could be ascribed to the fact that 84.7% of athletes believed that they have to increase their muscle mass in order to improve rugby performance and 46.8% of athletes indicated that supplements are important in order to support the load of their training programme (Walsh et al., 2011:367). Another misconception was that players believed that food would not provide enough micronutrients, making vitamin and mineral supplements necessary. Manore et al. (2017:6) found that male athletes use protein shakes/meal replacement products more often than female athletes. In contrast, the majority (89%) of athletes in the study by Sangeetha et al. 2014:974 did not make use of any ergogenic aids. A possible reason may be that the athletes were aware, that if prohibited substances are used and inappropriate eating habits are

adopted, it could have detrimental effects on the their health (Gradidge et al., 2011:115).

Although dietary supplements can play a significant role in helping athletes to consume adequate amounts of energy, carbohydrates and protein in their diet, supplements should not be seen as a replacement for a healthy diet (Kreider et al., 2010:13).

2.4 NUTRITION INTERVENTIONS

Athletes make use of many different resources to obtain nutrition information (Hoogenboom et al., 2009:143; Hornstorm et al., 2011:113; Walsh et al., 2011:369; Torres-McGehee et al., 2012:209; Davar, 2012:121; Valliant et al., 2012:512; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6). Numerous studies have shown that one of the main sources of nutrition information for young athletes is their coach (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328; Salami et al., 2017:4).

As previously discussed, very few coaches receive some or other formal nutrition training and may therefore not have adequate knowledge or be adequately equipped to provide nutrition advice to athletes (Juzwiak and Ancona-Lopez, 2004:224; Cockburn et al., 2014:1447; Salami et al., 2017:3).

The ideal situation for an athlete striving for optimal performance is to have access to sports nutritionists and/or dietitians (Torres-McGehee et al., 2012:207). This, however, is not always possible. Athletes who compete at a higher or more elite level, may have access to a sports dietitian more often, compared to high school and/or collegiate athletes (Devlin and Belski, 2015: 229). The availability of adequate funds or resources to hire dietitians or nutrition consultants for teams at high school or collegiate level remains a challenge (Hornstorm et al., 2011:111).

A more realistic approach is to ensure that athletes and coaches have the opportunity to gain sufficient knowledge or have adequate access to nutrition information (Cockburn et al., 2014:1444). Therefore, ongoing education programmes should be implemented to improve nutrition knowledge and to emphasise the importance of good

nutrition for optimal health and performance (Arazi and Hosseini 2012:105; Zinn et al., 2006:214; Shriver et al., 2013:13).

Several research studies, as summarised in Table 2.3 have concluded that nutrition education and intervention programmes can help improve knowledge and lead to better dietary habits of both athletes (Sangeetha et al., 2014:977; Valliant et al., 2012:514; Schwartz, 2014:46); Daniel et al. 2016:576) and coaches (Jacob et al., 2016:1313).

Table 2.3: Summary of studies investigating different nutritional interventions among athletes and coaches

Study and Country	Intervention sample and Sport code/level	Intervention method	Results	Conclusions
Daniel et al. (2016) Brazil	**Intervention sample** 10. **Sport code/level** Volleyball. (2016:569)	Food, nutrition and health education programmes, consisted out of 8 monthly meetings (1st meeting: profile information collected, 6 meetings: education intervention, last meeting: evaluate education programmes impact). (2016:569) Nutrition knowledge, intension to change behavior, body image dissatisfaction evaluation. (2016:568)	**Knowledge** Mean nutrition knowledge score before intervention (57%) and after intervention (63%). Mean knowledge score on macronutrients before intervention (72%) and after intervention (77.3%). Mean knowledge score on micronutrients before intervention (27%) and after intervention (38%). Mean knowledge score on food groups before intervention (98.9%) and after intervention (97.8%). Mean knowledge score on nutrition beliefs in sports before intervention (70.9%) and after intervention (58.2%). **Intention to change behavior** 5 out of 8 athletes advanced at least one stage after the education programme. 6 athletes intent to change their dietary behavior in the future at the finale meeting. (2016:571) **Body image dissatisfaction** Before education programme 6 athletes was dissatisfied, after education programme only 4 athletes were dissatisfied. (2016:572)	In general the education programme had a positive impact on nutrition knowledge and stage of intention to change behavior. (2016:575)
Jacob et al. (2016) Canada	**Intervention sample** Coaches of athletes aged 12-17 years. Comparison group: 20 Intervention group: 19 (2016:1307) **Sport code/level** Aesthetic, endurance,	Comparison and intervention group attended two 90min meetings over a period of two weeks. Registered dietitian presented lectures on recommendations for healthy eating and sport nutrition for adolescent athletes, focusing on macronutrients, micronutrients, hydration and food sources. (2016:1307) Intervention group received an decision-making algorithm (facilitating decision making regarding	**Demographics** No significant difference between social demographics between comparison and intervention group. **Knowledge** Mean nutrition knowledge score for comparison group (70.0%) and intervention group (72.3%) before intervention. Mean nutrition knowledge score for comparison group	The sports nutrition knowledge among coaches was inadequate and they will benefit from education. (2016:1313) Nutrition knowledge improved post intervention in both groups. But only the intervention group's knowledge was maintained during the 2-month

Study and Country	Intervention sample and Sport code/level	Intervention method	Results	Conclusions
	team sports. (2016:1310)	sports nutrition recommendations) at the end of the second meeting. (2016:1309) Coaches completed nutritional questionnaire 1 week after intervention and 2 months follow-up period (after intervention). Coaches kept nutrition dairy to write dietary recommendations they provided during the 2 month follow-up period. Nutrition knowledge evaluation, intention and behavior measurements. (2016:1310)	(82.7%%) and intervention group (81.7%) after 1-week post intervention. Mean nutrition knowledge score for comparison group (78%) and intervention group (81.5%) with the 2 month follow-up period. **Behavior** Accuracy on sport nutrition recommendation was better for the intervention group compared to comparison group after intervention. Accuracy on carbohydrates, protein and hydration recommendation was better for the intervention group compared to comparison group after intervention. (2016:1311)	follow-up period. (2016:1311) By adding a decision-making algorithm on sports nutrition recommendation as part of an intervention help retain knowledge over the 2 month follow-up period. (2016:1313)
Schwartz (2014) United States of America	**Intervention sample** 11. **Sport code/level** High school football players. (2014:33)	Nutritional education programme implemented over 8 weeks. Received one nutrition education newsletter via email and an educational meeting (±30min) weekly to discuss topic of the week. Body composition, nutrition knowledge, diet quality and perceived sports performance were measure before and after intervention. (2014:30)	**Knowledge** Mean nutrition knowledge score before intervention was 68% and after intervention was 72.7%. (2014:34) **Dietary intake** Significant improvement in vegetable intake and no significant improvement in fruit intake after intervention. (2014:35) **Perceived sport performance** After intervention 90.9% felt they ate better, 100% feel they perform and feel better. (2014:36) **Nutrition advice** Importance of nutrition, sources of dietary advice, requested information topic, preferred method for information. (2014:36)	After intervention only vegetable intake improved. When creating an educational intervention coaches and parents should be more involved, as they play a significant role in facilitating change in children. (2014:46)
Sangeetha et al. (2014)	**Intervention sample** 100 (20-35 years). (2012:971) **Sport code/level** Sportsperson from	Nutritional profile and dietary assessment collected. Nutrition education programme consisted out of one hour contact class. The class included power point	**Knowledge** Significant difference in the nutrition knowledge of sports person before and after education. (2012:974)	Significant improvement after educational programme.

Study and Country	Intervention sample and Sport code/level	Intervention method	Results	Conclusions
India	athletic events, group events, cricket, football, hockey, kho-kho kabady, handball, basketball, volleyball. (2012:971)	presentation and pamphlets hand-outs at the end of the programme. Athletes were evaluated before and after the nutrition intervention programme. (2012:971)	**Nutrition practice** 80% non-vegetarians, 15% vegetarians and the rest ovo-vegetarian. 52% of sports person took two meals/day, 25% three meals/day, 8% more than three meals/day, 10% two meals/day with snacks, 5% three meals/day with snack. 65% had the habit of skipping meals. (2012:972) The mean intake if all nutrients was less than the recommended daily allowance. (2012:973)	Poor nutrition knowledge reflected in their nutrient intake. Nutrition education created awareness which would in long run help improve nutritional status. (2012:977)
Valliant et al. (2012) United States of America	**Intervention sample** 11. **Sport code/level** NCAA Division 1 woman's volleyball. (2012:508)	First off season: Food dairy and record collected at beginning of non-intervention off-season and at the end of non-intervention off-season. No education given to athletes. Second off season: Food dairy and record collected each month. Individualized dietary education once every month for 4 months during the intervention season. (2012:508)	**Dietary intake** Failed to meet energy, carbohydrate, protein and fat recommendations over the two seasons. Significant improvement in energy, carbohydrate and protein intake after intervention. **Knowledge** Mean nutrition knowledge score significantly improved after intervention. (2012:510)	Nutritional education was useful in improving dietary intake and improving knowledge among athletes. (2012:514)

Jacob et al. (2016:1307) evaluated the effectiveness of a theory-based intervention on coaches' nutrition recommendations to their athletes. Coaches were divided into a comparison group and an intervention group. Both groups underwent a nutrition education intervention presented by a registered dietitian, but only the intervention group received a decision-making algorithm with recommendations (Jacob et al., 2016:1309).

An increase in nutrition knowledge in the comparison group and intervention group was reported, with the mean nutrition knowledge score improving from 72.3% to 81.7% and 70.0% to 82.7% respectively among coaches. Following the two-month follow-up after the nutrition education intervention, nutrition knowledge was maintained in the intervention group who had the decision-making algorithm available to guide them with recommendations (Jacob et al., 2016:1311).

This study concluded that more accurate recommendations were made among coaches who had an algorithm available to use, as they could use this decision-making algorithm to assist in implementing sports nutrition principles (Jacob et al., 2016:1313).

The most recent study in Table 2.3 measured the impact of an interdisciplinary educational programme on the nutrition knowledge, intention to change eating behaviour, and body dissatisfaction of adolescent Brazilian volleyball players (Daniel et al., 2016:567). The researchers designed a food, nutrition and health education programme based on identified inappropriate food intake, nutrition knowledge gaps, food beliefs and body dissatisfaction (Daniel et al., 2016:569).

The Brazilian volleyball players had a mean nutrition knowledge score of 57% before participating in the education programme. After six meetings, the mean nutrition knowledge score of players improved with 6% (Daniel et al., 2016:571). This improvement in knowledge on energy and macronutrient intake of a female volleyball team over two off-seasons was similar to the results reported by Valliant et al. (2012:511). It can therefore be concluded that nutrition education leads to the improvement of nutrition knowledge among athletes.

Daniel et al. (2016:571) also reported that athletes changed their behaviour after participating in the educational programme. Five of the eight athletes in the study advanced with at least one stage in the stages of behavioural change after the

education programme was implemented. At the final meeting of the education programme, six athletes indicated that they are planning on changing their dietary behaviour in the future (Daniel et al., 2016:571). Not only can nutrition education influence the health behaviour of athletes, but identifying the stages of "intention to change eating behaviour" can assist in planning appropriate nutrition education, with individuals in different stages of change benefitting from different types of educational messages (Jürgensen et al., 2015:285).

By engaging an athlete in nutrition education on an individual level, in a captivating way, using interesting methods and on a regular basis will effectively increase the knowledge of athletes and contribute to change in their nutritional practices (Sangeetha et al., 2014:977; Valliant et al., 2012:514; Schwartz, 2014:46; Daniel et al. 2016:576). Athletes generally have a positive attitude towards nutrition, thus athletes will most likely engage in nutrition education programmes (Azizi et al., 2010:107; Hornstrom et al., 2011:113; Davar, 2012:121; Valliant et al., 2012:514; Webb and Beckford, 2014:3)

It is mostly during the adolescent years that healthy nutrition behaviours and dietary practices are adopted, which have an effect on an individuals' health for many years to follow (Hu et al., 2016:192; Todd et al., 2015:2319). Hence, the adolescent life stage serves as an ideal opportunity for athletes to learn the basic nutrition principles (Manore et al., 2017:12).

2.5 SPORT NUTRITION PRINCIPLES FOR YOUNG ATHLETES

The most important goal for a young athlete is the consumption of a balanced diet in order to ensure growth, good health and achieve optimal performance (Purcell, 2013:2000; Smith et al., 2015:2; Bean, 2017:231)

The physiology of children do not differ fundamentally from adults (Smith et al., 2015:2) but children do have different nutrient requirements (Bean, 2017:234). Advice and recommendations are usually expressed per kilogram body weight, therefore the recommendations for adults are appropriate for children (Bean, 2017:231).

Guidelines related to the appropriate selection of foods and fluids, timing of intake, and supplement choices for optimal health and exercise performance have been well established (Cotugna et al., 2005:323, ADA/DC/ACSM, 2016:501; Bean, 2017:4).

Young athletes need to learn what foods are good sources of energy, when to eat certain foods, how to eat during an event, and when and what to eat to recover after activities (Bean, 2017:231).

Table 2.4 summarises the general nutrition recommendations for young athletes between the ages of four to 18 years.

A well-balanced diet containing appropriate amounts of macronutrients (protein, carbohydrates and fat) and micronutrients (vitamins and minerals) is essential to provide enough energy for growth and activity (Purcell, 2013:200).

Table 2.4: Summary of the general nutrition recommendations for adolescents (4 – 18 years)

	General Nutrition Recommendations
Carbohydrates	45% - 65% of energy intake should come from carbohydrates (Otten et al., 2006:539), or 3g/kg - 8g/kg of carbohydrates (Smith et al., 2015:5).
Protein	10% - 30% of total energy intake should come from protein (Otten et al., 2006:539), or 1.2 - 2.0g/kg body weight per day (ADA/DC/ACSM, 2016:510; Bean, 2017:234).
Fat	25% to 35% of total energy intake should come from fat (Otten et al., 2006:539; ADA/DC/ACSM, 2016:512).
Micronutrients	The daily recommended intake for Calcium: 1300 mg/day (Institute of Medicine Dietary reference intakes for calcium and vitamin D: 2018). The daily recommended intake for Iron: 15 mg/day for females and 11 mg/day for males (Otten et al., 2006:540). The daily recommended intake for Vitamin D: 600 IU/day (Institute of Medicine Dietary reference intakes for calcium and vitamin D: 2018). Vitamin and mineral needs can be easily met by the consumption of a balanced health diet (Smith et al., 2015:8).
Hydration/Fluid	The daily recommendation for water: 1.7 L/d for children, 4 – 8years, 2.4 L/d for males, 9 – 13years, 3.3 L/d for Males, 14 – 18 years, 2.1 L/d for Females, 9 – 13years and 2.3 L/d for females,14 – 18years. Proper hydration requires fluid intake before, during and after exercise or activity (Purcell, 2013:201).
Weight Control	Weight loss can be achieved by increasing daily activity level and training intensity together with a healthier diet (Bean, 2017:245). Weight gain can be achieved through additional energy intake and strength training (ADA/DC/ ACSM, 2017:506).

2.5.1 ENERGY

An athlete engaging in intense training of two to three hours per day for five to six days per week, or high volume training of three to six days a week may expend up to an additional 2520-5040kJ per day (Dorfman, 2012:511). Athletes engaged in these intense training programmes often find it difficult to meet their increased energy needs (Kreider et al., 2010:8). Other challenges that make it difficult to meet energy needs include: school schedules, budgets, cafeteria schedules, travel requirements and a varying appetite (Dorfman, 2012:511).

The intake of enough energy for growth and development is important, while supporting the energy expenditure for exercising (Smith et al., 2015:2). Inadequate energy intake will result in poor performance, because the body will use lean muscle tissue for energy. Over time, insufficient energy will lead to a reduction in strength and increase the risk for nutrient deficiencies that could lead to osteoporosis, anaemia and stunted growth (Purcell, 2013:200; ADA/DC/ACSM, 2016:505). It is thus important to ensure that athletes are well fed and consume enough energy to balance the increased energy demands of training, and to maintain their body weight (Kreider et al., 2010:8).

Table 2.5 summarises the energy recommendations for boys and girls, participating in moderate and heavy physical activity. Age, gender, body size, the amount of fat free mass, growth rate, as well as the type, duration and frequency of exercise influences the energy requirements of athletes (Purcell, 2013:200; Smith et al., 2015:2; Bean, 2017:5).

Table 2.5: Summary of the daily energy requirement for boys and girls participating in moderate and heavy physical activities (*Adapted from FAO/WHO/UNU, 2004)*

Age (years)	Moderate physical activity		Heavy physical activity	
	Boys (kJ/day)	Girls (kJ/day)	Boys (kJ/day)	Girls (kJ/day)
6-7	6615	5985	7560	6930
7-8	7140	6510	8190	7455
8-9	7665	7140	8820	8190
9-10	8295	7770	9555	8925
10-11	9030	8400	10395	9660
11-12	9870	9030	11340	10395
12-13	10710	9555	12285	11025
13-14	11655	9975	13335	11445

14-15	12600	10290	14490	11991
15-16	13335	10500	15330	12075
16-17	13965	10500	16065	12075
17-18	14280	10500	16485	12075

2.5.2 CARBOHYDRATES

Carbohydrates provide glucose that is used for energy, making it the most important fuel source for athletes (Purcell, 2013:200). In addition to meeting energy needs, it is also needed to maintain blood glucose levels and to restore muscle glycogen stores after exercise (Bean, 2017:35).

For four- to 18-year-olds, 45% to 65% of their total energy intake should be from carbohydrates (Otten et al., 2006:539) or, depending on training type and intensity, between three to eight grams of carbohydrate per kilogram per day (Smith et al., 2015:5).

It is preferred that the majority of dietary carbohydrate should be from complex carbohydrates with a low to moderate glycaemic index. Many nutritionists and/or dietitians, however, recommend that athletes also make use of concentrated carbohydrate juices/drinks and/or consume high carbohydrate supplements to meet their carbohydrate needs, as it is difficult to consume these large amounts of carbohydrates when an athlete is involved in intense training (Kreider et al., 2010:8).

Recommendations for daily carbohydrate intake should focus on providing the recommended amount of carbohydrates in grams, relative to body mass, and allow flexibility to meet these targets within the context of the athlete's energy needs and other dietary goals (Dorfman, 2012:512).

In order to optimise carbohydrate availability, the types of carbohydrate ingested prior to, during, and following intense exercise plays an important role (ADA/DC/ACSM, 2016:508). Table 2.6 summarises the daily carbohydrate requirements for different physical activities (Potgieter, 2013:9).

Table 2.6: Summary of the daily carbohydrate requirement for physical activities (*Adapted from Potgieter, 2013)*

Pre-event/training carbohydrate requirements		
Dietitians of Canada and the American College of Sport Medicine		
Physical activity level	Carbohydrate intake/day	
	200-300g 3-4 hours prior to event	Low in fibre and fat High carbohydrates, moderate protein
International Society of Sports Nutrition		
Carbohydrate loading	8 – 10 g/kg 1-3 days prior to event	High GI carbohydrate diet
Pre-event meal	1 –2 g/kg 3-4 hours prior to event	
International Olympic Committee		
Carbohydrate-loading preparation for events > 60 minutes sustained or intermittent exercise	10 – 12 g/kg 36 – 48 hours prior to event	Low in fibre Individual tolerance Avoid high-fat protein and fibre Low GI if no CHO during exercise
Pre-event fueling before exercise > 60 minutes	1 – 4 g/kg 1-4 hours prior to exercise	
During event or training carbohydrate requirements		
Dietitians of Canada and the American College of Sport Medicine		
Physical activity level	Carbohydrate intake/day	
During exercise > 60 min	30-60g/hour	6-8% carbohydrate solution Primarily glucose
International Society of Sports Nutrition		
During events > 60 minutes	30 – 60g/hour	6-8% carbohydrate solution Primarily glucose Start drinking early and continue drinking small amounts every 15-20 minutes. Combination of carbohydrates increase oxidation
International Olympic Committee		
Brief exercise < 45 min	Not needed	

During sustained high-intensity exercise lasting 45-75 min	Small amounts including mouth rinse	Combination of carbohydrates increase oxidation
During endurance exercise including "stop and start" sports lasting 1 – 2½ hours	30 – 60g/hour	
During ultra-endurance exercise lasting > 2½ - 3 hours	Up to 90 g/hour	
Post-event or training carbohydrate requirements		
Dietitians of Canada and the American College of Sport Medicine		
Physical activity level	Carbohydrate intake/day	
30-60g/hour	1.0-1.5 g/kg during the first 30 min, and again every 2 hours	Adequate fluid, electrolytes, energy and carbohydrates
International Society of Sports Nutrition		
Post-exercise carbohydrate ingestion	0.6 -1.0 g/kg during the first 30 min, and again every 2 hours for 4-6 hours	Within 30 minutes post-exercise
International Olympic Committee		
Speedy refueling, < 8 hours recovery between two fuel-demanding sessions	1-1.2 g/kg /hour for first 4 hours, then resume daily fuel needs	Small, regular snacks Compact carbohydrate-rich foods

2.5.3 PROTEIN

Protein is required for growth, repair and formation of new tissue as well as hormone and enzyme production. Protein further assists to maintain fluid balance and helps to defend the body against disease (Cotugna et al., 2005:324; Bean, 2017:75).

Athletes have a slightly higher protein requirement when compared to the general population (Cotugna et al., 2005:324; Smith et al., 2015:5). The current protein recommendation for athletes is 1.2 to 2.0g/kg body weight per day (ADA/DC/ACSM, 2016:510), a recommendation which seems to be adequate for young growing athletes as well (Bean, 2017:234). The Dietary Reference Intake for protein for four-

to 18-year-olds are approximately 10% to 30% of total energy intake (Otten et al., 2006:539).

The potential increased need for dietary protein does not warrant additional protein supplements. A well balanced, varied diet containing complete foods, such as meat, fish, chicken, and low fat dairy products will provide the additional protein required (Burke and Cox, 2012:50), especially with an increased intake in energy. Good sources of protein include lean meat and poultry, fish, eggs, dairy products, beans and nuts (Bean, 2017:234).

Following a high protein diet affects the athlete's carbohydrate intake, which may affect their ability to train and compete at peak levels and therefore consuming more protein than needed is not necessary and should be avoided (Dorfman, 2012:514). High protein intakes can also result in diuresis and potential dehydration, increasing the workload on the kidneys, and can also have a negative effect on calcium balance (Burke and Cox, 2012:52).

2.5.4 FAT

Fat is an important source of energy, facilitates absorptions of fat-soluble vitamins (A, D, E and K) and provides insulation to internal organs (Smith et al., 2015:4). Fat intake for four- to 18-year-olds should be 25% to 35% of their total energy intake (Otten et al., 2006:539; ADA/DC/ACSM, 2016:512). Good sources of fat include lean meat and poultry, fish, nuts, seeds, dairy products, olive and canola oils (Purcell, 2013:200).

2.5.5 MICRONUTRIENTS

Vitamins do not provide energy to the body but they are involved in energy metabolism by acting as coenzymes in metabolic reactions. Vitamins are also involved in the production of red blood cells, the action of antioxidants, the repair of tissue, and the synthesis of protein (Burke and Cox, 2012:54). Minerals serve as structure for tissue, important components of enzymes and hormones, and regulators of metabolic and neural control (Kreider et al., 2010:11; Smith et al., 2015:7).

Micronutrient deficiencies can lead to a lack of energy and increase the risk for minor infections or illnesses (Bean, 2017:96). When a deficiency in micronutrients occur in the human body, the micronutrient is prioritised for short term survival at the expense of long-term health, causing disabling of DNA repair. This in turn leads to an increased

risk of developing chronic diseases on the long term (Ames, 2010: 5). This prioritisation of nutrient use is known as the 'triage theory' and provides a link between chronic, marginal deficiency of a micronutrient and many degenerative diseases (Ames, 2010: 2).

Calcium is essential for bone health, muscle contraction and enzyme activity (Smith et al., 2015:8). Although blood calcium levels are sustained within normal levels to ensure optimal function of the body, a daily recommended intake of 1300 mg calcium is required to prevent functional stores to be withdrawn from the body, leading to low bone density later in life (IOM:2018). Milk, yogurt, cheese, broccoli, spinach and fortified grain products are some of the recommended calcium rich foods and beverages (Purcell, 2013:201).

Vitamin D is necessary for bone health and plays a role in the absorption and regulation of calcium (ADA/DC/ACSM, 2016:513). Current recommendations suggest an intake or production of 600 IU/day (IOM:2018). Sources of vitamin D include fortified foods (such as milk) and synthesis in the skin during sun exposure (Purcell, 2013:201).

Iron is important for oxygen delivery to body tissues (Purcell, 2013:201) and iron deficiency can impair the function of muscles (ADA/DC/ACSM, 2016:512). Four- to 18-year-olds require up to 15 mg iron/day for females and 11 mg/day for males (Otten et al., 2006:540). Iron depletion is common among athletes because of poor diets or increased iron losses in urine, faeces, sweat or menstrual blood. Female athletes, vegetarians and distance runners are at greatest risk for iron deficiency and should be monitored on a regular basis (ADA/DC/ACSM, 2016:513). In accordance with the American College of Sports Medicine (ACSM), American Dietetic Association (ADA) and Dietitians of Canada (DC), iron status should be maintained through the consumption of iron rich foods like eggs, leafy green vegetables, fortified whole grains and lean meat (Purcell, 2013:201).

Vitamins and minerals are essential nutrients in order for the body to work properly. By consuming a balanced diet, micronutrient needs can easily be met (Cotugna et al., 2005:324).

Due to daily constraints among young athletes, the risk for micronutrients deficiencies are however prevalent (Smith *et al*., 2015:7). Efforts should first be made to correct dietary intake through food, as this is the healthier and preferred treatment option. Should a dietary deficiency exist a multivitamin/multimineral supplement may help achieve a recommended intake (Blumberg *et al*., 2018:12).

2.5.6 HYDRATION

The body generates heat during physical activity and responds by sweating to maintain temperature homeostasis in the body. Water lost through sweating needs to be replaced, making hydration vital to ensure the athlete's performance and health is maintained. Dehydration reduces aerobic, anaerobic and cognitive performance. An athlete who loses too much water due to dehydration can experience a decrease in performance and may have a greater risk for developing heat stroke (ADA/DC/ACSM, 2016:514). Both weight gain and excessive weight loss due to fluid intake or loss should be avoided (Bean, 2017:241).

There is no reason to change these guidelines for children because recommendations are based on individual sweat rates (Bean, 2017:241).

Proper hydration requires fluid intake before, during and after exercise or activity (Purcell, 2013:201). The aim for any athlete is to be well hydrated before exercise. The consumption of 1 to 1.5 litres of fluid during the day before an event and as a final measure topping up with 150 to 200ml of water 45 minutes before exercise is recommended. During an event, athletes should consume 75 to 100ml of fluid every 15 to 20 minutes (Bean, 2017:241). For events lasting longer than 1 hour, sports drinks containing 4 to 8% carbohydrates are useful to maintain blood sugar levels and ensure optimal hydration often with mineral replacement. During recovery, a fluid intake of about 1.25 L or 1.5 L for every 1 kg body weight (ADA/DC/ACSM, 2016:516) or 300ml for every 0.2 kg of weight lost during exercise is required (Bean, 2017:242) .

2.5.7 NUTRIENT TIMING

The timing of food consumption, based on the time of a competition or exercise, is important to ensure optimal performance (Purcell, 2013:201).

A general guideline to allow for proper digestion and to minimise the incidence of gastrointestinal upset during exercise is consuming meals at least one to four hours

before a competition (ADA/DC/ACSM, 2016:516, Bean, 2017:237). The pre-event meal should be low in fat, fibre, and caffeine; moderate in protein; and high in complex carbohydrates and fluid (ADA/DC/ACSM, 2016:516). Pre-game snacks or liquid meals should be ingested one to two hours before an event. Snacks can include fresh fruit, dried fruit, a bowl of cereal with milk, juice or fruit-based smoothies (ADA/DC/ACSM, 2016:516; Bean, 2017:235).

Sports drinks, fruit or granola bars can be ingested during an event to help refuel and provide energy (Bean, 2017:237). For exercise lasting longer than 60 minutes, it is beneficial to maintain blood sugar levels by consuming about 30 to 60 grams of carbohydrate per hour via sports drinks (Smith et al., 2015:6).

Adequate energy, in the form of carbohydrate, must be consumed to replenish glycogen stores; and protein (in moderate amounts) for muscle repair, after an event (ADA/DC/ACSM, 2017:516). Recovery foods should be consumed within 30 minutes after exercise, and again within one to two hours of exercise to allow for proper recovery (Bean, 2017:238). A mixed carbohydrate and protein meal should follow a workout, with balanced meals following every two to four hours in order to create an ideal environment for muscle recovery and glycogen storage (Bean, 2017:207).

2.5.8 WEIGHT CONTROL

Some athletes may be striving for a certain physique and would want either to gain weight (such as for football) or to lose weight (such as for gymnastics, skating, wrestling) in order to improve their performance (ADA/DC/ACSM, 2017:505; Bean, 2017:245).

Weight change should be achieved steadily and should occur months before the start of the competitive season or event (Bean, 2017:245). In order to lose weight, daily activity levels and training intensity should be increased together with following a healthier diet (Bean, 2017:245). Weight gain, on the other hand, can be achieved through additional energy intake and strength training (ADA/DC/ ACSM, 2017:506).

2.6 CONCLUSION

This literature review was aimed at providing an overview of the nutrition knowledge and advice practices of coaches and athletes as well as different intervention strategies used as described in the literature.

Nutritional practices are not always according to established recommendations and guidelines and often common nutrition misconceptions exist amongst athletes. In addition, athletes mostly make use of unreliable information sources, which further contribute to the problem of poor nutrition choices and a lack of knowledge.

Coaches take up an important position within a team and most athletes rely on their coaches for nutrition advice. Thus, coaches serve as an important source of information for athletes and it is therefore important that coaches provide correct and accurate information.

Poor nutrition knowledge is often described among coaches, and many coaches do not have any formal nutrition training or make use of professionals like dietitians to obtain nutritional advice. Therefore, coaches can generally not be regarded as a reliable source to communicate nutritional information, strategies and/or make recommendations to athletes.

Having access to sport nutritionists and/or dietitians on a regular basis would be an ideal solution for athletes and coaches to improve nutrition knowledge and practices. However, this is not always possible and a more realistic approach is required to ensure that athletes and coaches have sufficient nutrition knowledge or access to reliable nutrition information.

Nutrition education and intervention programmes have shown to assist in the improvement of knowledge and lead to better dietary habits amongst athletes and coaches. Ongoing education programmes should, therefore, be implemented on a regular basis.

Evaluating the nutrition knowledge and accuracy of nutritional advice provided by coaches will help dietitians and nutritionists identify knowledge gaps in nutrition amongst coaches, which will assist in the development and implementation of appropriate intervention strategies.

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3. METHODOLOGY

3.1 INTRODUCTION

The study sample, measurements, techniques, procedures, role of the researcher, statistical analysis and ethical considerations of the study are discussed in this chapter.

3.2 STUDY DESIGN

A cross-sectional, descriptive study was conducted amongst netball coaches of u/16 and u/18 teams, who participate in the first or second netball league in the Free State province.

3.2.1 SAMPLE AND POPULATION

The study population consisted of all coaches involved in coaching an u/16 and/or u/18 netball team, playing in the first and/or second netball league in the Free State Province.

A total of 44 Coaches' contact details were obtained from the Free State Netball Federation. Coaches were informed about the study and invited to participate via email (Addendum C).

All u/16 and u/18 netball coaches with players competing in the first or second league in the Free State were invited to participate in the study and a convenience sample of all coaches willing to participate in the study was included. A total of 34 coaches, responsible for training u/16 and u/18 netball players, in the first or second league of the Free State province responded to the invitation and were willing to participate in the study.

In order to optimise response rate, a follow-up invitation was sent out to coaches to complete the questionnaire, while an incentive in the form of a coaching course and netball equipment was offered to one winning coach, who was randomly selected from those coaches who complete the questionnaire.

Of the 44 coaches that were approached to participate in the current study, 34 completed the questionnaire, resulting in a response rate of 77.3%.

3.3 MEASUREMENTS

To reach the aim and objectives of this study, the following data were collected under the following sections: demographic background of coaches and facilities available; sports nutrition knowledge of the coaches and nutritional advice practices of the coaches.

3.4 VARIABLES AND OPERATIONAL DEFINITIONS

3.4.1 DEMOGRAPHIC BACKGROUND AND FACILITIES AVAILABLE

Demographic information included the participants' age, ethnicity, gender, team coached, netball league, coaching level, number of years coaching, nutrition education or training received, healthcare support and facilities available. Demographic information were collected by means of a self-reported online questionnaire (Addendum E).

Age was recorded to distinguish between younger and older coaches. The date of completion of the questionnaire, current age and birth date was asked in the questionnaire. The median age of coaches was used as the cut-off point to distinguish between younger and older coaches.

The participants' ethnicity or race was captured to describe how participants' culture may influence the response to questions regarding cultural practices.

Coaching level referred to the level of accreditation obtained from the Netball Coaches Association and was categorised as: Pre-Level (Registered), Level 1, Level 2 and Level 3 or Not registered. Participants were required to indicate one of these categories.

The number of years coaching, referred to the number of years the participant has been involved in coaching of netball. Coaches were required to indicate the specific number of years and these were categorised as: Less than 1 year, between 1-5 years, between 5 -10 years, and more than 10 years.

Nutrition education referred to whether or not coaches received any formal education or training with regard to nutrition, if they received such training, the content of the training and the duration thereof. The options provided were based on published literature. Data were used to distinguish between the knowledge and advice practises

of participants who received education and those who did not.

Coaches were required to indicate what type of information sources they make use of to obtain information about nutrition. Participants listed main sources of information, which were grouped for reporting purposes. Source of information was used to determine the origin of their knowledge and advice practises.

Facilities available referred to the amount of matches played in a netball season (detailed), the availability of sporting facilities (including access to gymnasiums, indoor or outdoor netball courts or no access at all) and the availability of health support (including access to sports nutritionists, dietitians, doctors, strength and conditioning trainers and physiotherapists).

3.4.2 SPORTS NUTRITION KNOWLEDGE

For the purpose of this study, the participants' knowledge was evaluated by means of questions based on an in-depth literature review as well as questionnaires used in previous similar studies (Zinn *et al*., 2006; Schwartz, 2014; Horvath *et al.,* 2014). To ensure applicability to South African eating patterns and local eating practices, questions based on the South African Food-based Dietary Guidelines (SA FBDG) were incorporated into the questionnaire. Sports nutrition knowledge was based on the coaches' knowledge on general healthy eating, fluid/hydration requirements, weight loss, pre-training/ competition and during training/competition food intake, recovery as well as supplement and ergogenic aid use. One mark was awarded for each correct answer given in order to calculate the total for sports nutrition knowledge score of each participant.

3.4.3 NUTRITIONAL ADVICE PRACTICES

For the purpose of this study, the coaches' dietary advice practices were evaluated by means of questions based on an in-depth literature review as well as questionnaires used in similar previous studies (Zinn et al., 2006) (Addendum E)

Questions on whether or not they impart nutritional advice, type of advice the coach typically provided to athletes with regard to nutrient intake, fluid requirements, recovery meals, weight control, the use of supplements and ergogenic aids as well as their perceived contribution, what sources they make use of to gain information and

whether they make use of nutrition professionals or not, were included in the questionnaire.

3.5 TECHNIQUES

After obtaining approval from the Health Sciences Research Ethics Committee from the University of the Free State (HSREC 185_2016) and Netball South Africa, coaches' contact information were obtained from officials forming part of the Free State Netball Federation. Coaches were invited through email (Addendum C) to participate in the study. Those who were willing to participate in the study completed an online, electronic questionnaire (Addendum E).

3.5.1 QUESTIONNAIRE

EvaSys software was used to design the online questionnaire and to capture the data. A link to the online questionnaire was distributed to participants via email. After completion of the questionnaire, data was automatically exported and captured onto an Excel document.

To discourage coaches from leaving questions unanswered, the questionnaire consisted of mostly closed format questions. Open-ended questions were also included to enrich data and were categorised during the capturing of the data.

3.6 VALIDITY AND RELIABILITY

3.6.1 VALIDITY

Validity is defined as the degree to which instruments achieve the function for which they are being used (Wothern et al., 1993; Mehrens and Lehman, 1987). Validity was ensured by including only questions directly related to the aim of the study. Questions were based on an in-depth literature study. The questionnaire was tested in a pilot study to ensure that questions were clear and understandable.

3.6.2 RELIABILITY

Reliability refers to the degree of similarity between measures (Wothern et al., 1993; Mehrens and Lehman, 1987). Reliability was improved by making questionnaires available in easily understandable language. This was to ensure that the response rate is high and to keep respondent burden low.

The questionnaire was based on an in-depth literature review as well as questionnaires used in previous similar studies (Zinn *et al*., 2006; Schwartz, 2014; Horvath et al., 2014).

Reliability was further increased by keeping questionnaires anonymous, allowing self-completion of the questionnaire and reassuring respondents that all results were kept strictly confidential.

3.7 PROCEDURE FOLLOWED DURING THE STUDY

The procedures followed during the study is described in Figure 3.1 and includes:

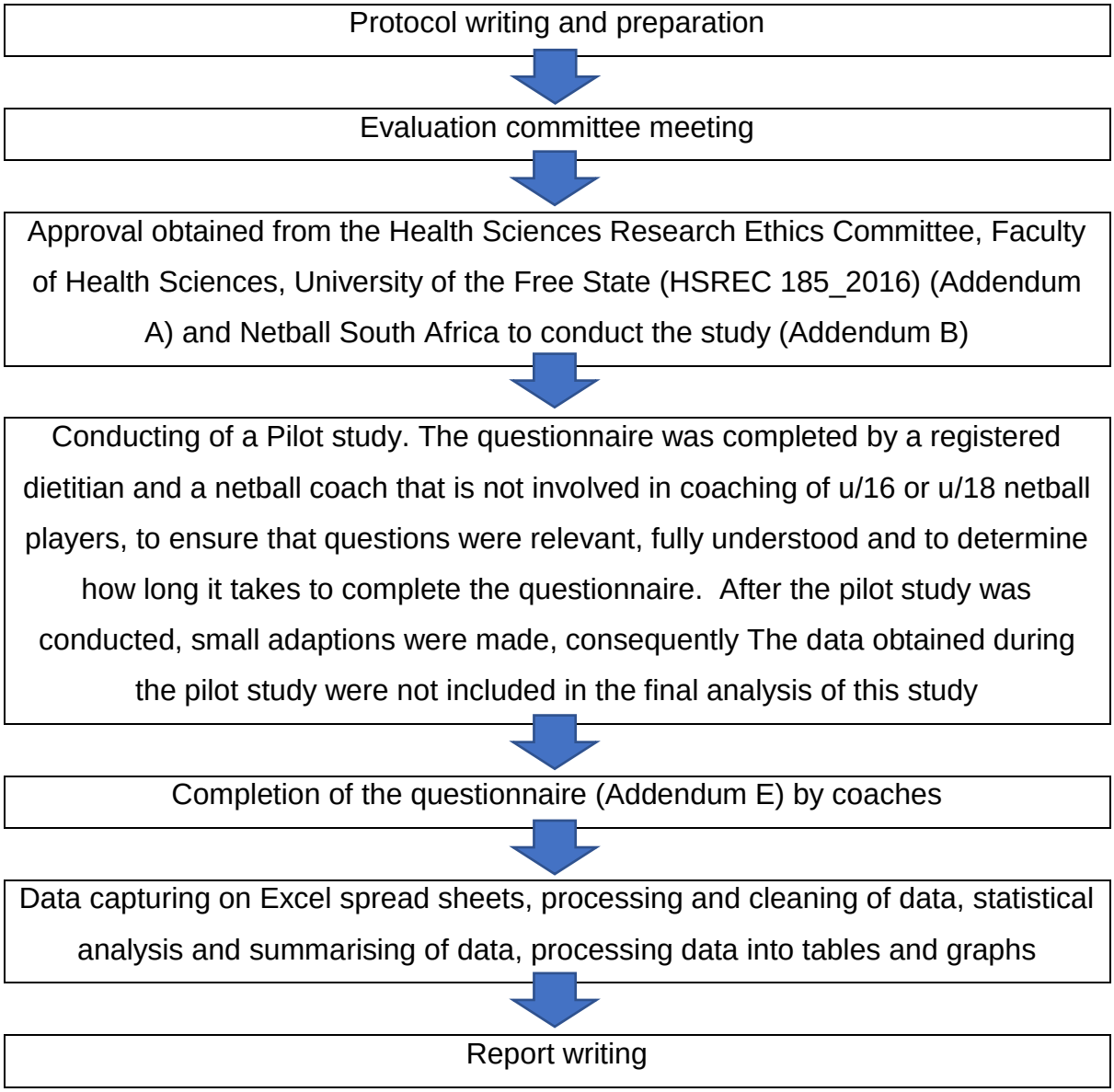

Figure 3.1: Procedure of the current study

The study results as well as the literature review was summarised and made available to coaches through Netball South Africa (NSA). The research report is written in an article format that will be submitted for publication to peer-reviewed scientific journals.

3.8 ROLE OF THE RESEARCHER

As studies in other countries describe a lack of nutrition knowledge among coaches and athletes, it is important that knowledge be evaluated and addressed to ensure optimal nutrition for athletic performance as well as for the development, growth and overall health of the growing adolescent (Cockburn *et al.*, 2014:1443).

After the protocol and in-depth literature review writing the researcher developed the questionnaire to collect data. The researcher communicated with the Netball community and invited participants to participate in research study. Data collected in this study were analysed statistically and interpreted. Results and findings were interpreted after which the researcher wrote the report.

The researcher was involved in providing nutrition education and information documents to Netball South Africa and netball coaches.

As no study has previously been performed in South Africa to describe the nutrition knowledge and nutritional advice practices of netball coaches, this study provides valuable information on the nutrition knowledge and advice practices of netball coaches.

3.9 STATISTICAL ANALYSIS

Statistical analysis of the data was performed by the Department of Biostatistics from the Faculty of Health Sciences, University of the Free State using SAS software (SAS; version 9.2 for Windows; Cary, NC). Descriptive statistics, namely frequencies and percentages for categorical data and means and standard deviations or medians and percentiles for categorical data, were used.

3.10 ETHICAL CONSIDERATIONS

Approval was obtained from the Health Sciences Research Ethics Committee of the University of the Free State (HSREC 185_2016) (Addendum A). Permission was also obtained from Netball South Africa (Addendum B). After approval was obtained, consent was obtained from participating coaches. A consent document (Addendum

D) was included and formed part of the online questionnaire. An information document was provided to the coaches (Addendum C) that briefly explained the purpose of the study. All information was provided in English and in a manner that was easy to understand by all participants. All information obtained from the questionnaires was kept strictly confidential, and was only used for the purpose of this study. The participants were not identifiable by name. Participants were informed that the results of the study may be presented at scientific forums and in publications, but the particulars of the participants will not be revealed.

3.11 SUMMARY

A sample of 34 netball coaches in the Free State provided consent and completed the online questionnaire (Addendum E). For the purpose of the study the demographic background of coaches and facilities; sports nutrition knowledge and nutritional advice practices of the coaches were determined using valid and reliable measurements.

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4. NUTRITION KNOWLEDGE OF NETBALL COACHES IN THE FREE STATE

This chapter is written in article format and reports on the findings of data collected for this study according to the first objectives of this study, which includes determining the demographic background and facilities available to coaches that train under 16 and under 18 netball players in the first or second netball league in the Free State. This article has been written with the goal of submission to the South African Journal for Research in Sport, Physical Education and Recreation (SAJR) and therefore the author guidelines of the SAJR (Addendum F) have been followed with the exception of the referencing style which is done according to the requirements of the Department of Nutrition and Dietetics, University of the Free State.

ABSTRACT

Coaches are one of the primary sources of nutrition information for young athletes. Their position in a team provides them with the opportunity to influence the dietary intake of *young athletes. This descriptive study investigated the demographic and nutrition knowledge of under 16 and under 18, first or second league netball coaches in the Free State. Forty-four coaches in the Free State were contacted, of which 34 completed the online questionnaire used to collect data. No significant difference in nutrition knowledge was observed between team coached, netball league, coaching level, number of years coaching and nutrition education or nutrition training received. Coaches obtained a median nutrition knowledge score of 64.7%. Only four coaches displayed adequate knowledge, which represents 13.3% of the under 16 coaches, 10.5% of the under 18 coaches, 11.1% of coaches competing in the first league and 16.7% of coaches competing in the second league. Of the level 1, level 2 and level 3 coaches, 9.5%, 14.4% and 25.0% showed adequate knowledge, respectively. Two (9.5%) of the coaches with 1 to 15 years of experience and two (15.4%) of the coaches with more than 16 years of coaching experience displayed sufficient knowledge*. *A small percentage (29.4%) of the coaches previously received nutrition education or training. Overall, 41.2% had no access to healthcare professionals available. Coaches in this study demonstrated a lack of nutrition knowledge, which does not qualify them as suitable information sources for young athletes. These findings*

indicate the importance of developing nutrition education programmes aimed at coaches, in order to enhance nutrition knowledge.

4.1 INTRODUCTION

Optimal nutrition is one of the most important factors affecting performance in any physically active individual (Potgieter, 2013:6; ADA/DC/ACSM, 2016:501). Regardless of the sport type and competing level, optimal nutrition is not just important for athletic performance, but also vital for development, growth and overall health, especially in the growing adolescent (Bean, 2017:231).

Despite the fact that general guidelines for healthy eating and international sports nutrition recommendations are available (ADA/DC/ACSM, 2016:501), dietary practices among athletes are still not optimal (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Sangeetha et al., 2014:973; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Valliant et al., 2012:510; Shriver et al., 2013:13; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20).

A study among high school athletes by Manore et al. (2017:1) investigated male and female soccer players' nutrition knowledge, behaviours and beliefs and whether there is a difference in these variables between gender, race/ethnic groups or socioeconomic status. The study reported that soccer players obtained a low nutrition knowledge score of 45.6%, which showed a lack of nutrition knowledge among high school athletes (Manore et al., 2017:20). Manore et al. (2017:7) further reported that Latino athletes in their study had significantly lower nutrition knowledge scores compared to Caucasian athletes, while male athletes displayed better nutrition knowledge than females (Manore et al., 2017:4).

Poor knowledge has been identified, among many reasons, as to why good nutrition practices are not always followed (Davar, 2012:123), resulting in poor eating habits and unhealthy eating (Cotugna et al., 2005:326).

Insufficient energy and carbohydrate intake (Hoogenboom et al., 2009:144; Sangeetha et al., 2014:973; Valliant et al., 2012:510; Shriver et al., 2013:13), micronutrient insufficiencies (Hoogenboom et al., 2009:143; Sangeetha et al.,

2014:973), skipping meals (Hoogenboom et al., 2009:145; Sangeetha et al., 2014:972; Valliant et al., 2012:513; Shriver et al., 2013:13), supplement misuse (Walsh et al., 2011:367; Sangeetha et al., 2014:974; Jürgensen et al., 2015:285; Manore et al., 2017:6) and poor nutrient timing (Davar, 2012:122; Walsh et al., 2011:367; Manore et al., 2017:6) are some of the concerning dietary practices often observed amongst athletes.

Athletes make use of various different resources to obtain nutrition information (Hoogenboom et al., 2009:143; Hornstorm et al., 2011:113; Walsh et al., 2011:369; Torres-McGehee et al., 2012:209; Davar, 2012:121; Valliant et al., 2012:512; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46). Numerous studies have shown that coaches are one of the main sources of nutritional information for young athletes (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328; Salami et al., 2017:4), immediately questioning whether knowledge was adequate.

Nutrition experts, such as dietitians, are often not accessible to athletes or athletes may feel more comfortable to obtain nutrition advice from coaches. This might be due to the important position that coaches take up in a team environment and the close relationships that exist between athletes and coaches (Torres-McGehee et al., 2012:207). Because of their important role as a source of information, it is therefore important for coaches to provide correct and accurate information (Botsis and Holden, 2015:198) as coaches have the authority and responsibility within the team to influence important decisions of young athletes.

Various studies however report on the reality that coaches demonstrate a lack of knowledge when it comes to nutrition (Rockwell et al., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn et al., 2006:224; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1447; Botsis and Holden, 2015:198; Couture et al., 2015:332; Salami et al., 2017:6), questioning their suitability to be a source of information to advise athletes appropriately.

Research has shown that demographic characteristics, including the gender of the athletes who were coached (Rockwell et al., 2001:177; Botsis and Holden, 2015:197),

the gender of the coach (Rockwell et al., 2001:177; Couture et al., 2015:329), years of experience (Rockwell et al., 2001:177; Botsis and Holden, 2015:197; Salami et al., 2017:5), level of coaching (Juzwiak and Ancona-Lopez, 2004:228; Couture et al., 2015:329; Salami et al., 2017:5), formal nutrition training received (Zinn et al., 2006:220; Cockburn et al., 2014: 1447; Salami et al., 2017:3) and different sport categories (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez, 2004:230; Couture et al., 2015:329) can be related to the level of nutrition knowledge of the coach.

As can be expected, most coaches do not have any formal nutrition training (Juzwiak and Ancona-Lopez, 2004:224; Cockburn et al., 2014:1447; Salami et al., 2017:3), and only a small percentage of coaches make use of professionals (like dietitians) to obtain nutrition advice (Zinn et al., 2006:220; Juzwiak and Lopez, 2004:225; Torres-McGehee et al., 2012:208; Cockburn et al., 2014:1448; Couture et al., 2015:328; Salami et al., 2017:3).

To ensure better nutrition knowledge amongst coaches, it is recommended that emphasis should be placed on nutrition education of coaches (Jacob et al., 2016:1313). Various authors have agreed that it is important to ensure that coaches obtain information from reliable sources and receive ongoing nutrition training in order to best support their athletes (Zinn et al., 2006:224; Torres-McGehee et al., 2012:211; Cockburn et al., 2014:1451).

The adolescent life stage serves as an ideal opportunity for athletes to learn the basic nutrition principles (Manore et al., 2017:12) and it is mostly during the adolescent years that healthy nutrition behaviours and dietary practices are adopted, which have an effect on an individuals' health for many years to follow (Hu et al., 2016:192; Todd et al., 2015:2319). Hence, why it is important to differentiate between coaches who have accurate knowledge, those with incorrect knowledge, and those who do not have any knowledge (Zinn et al., 2006:224).

Therefore, the purpose of this study was to determine and describe the demographic background and nutrition knowledge of under 16 and under 18 first or second league netball coaches in the Free State.

4.2 METHODOLOGY

4.2.1 STUDY POPULATION AND SAMPLE SELECTION

The study population consisted of 44 coaches involved in the coaching of under 16 and under 18 netball players competing in the first or second league in the Free State in 2018. Convenience sampling was used and all 44 coaches were contacted and invited to participate in the study via email. Thirty-four of the coaches responded to the invitation and were willing to participate in the current study (response rate = 77.3%).

4.2.2 PROCEDURE

Following approval from the Health Sciences Research Ethics Committee (HSREC 185_2016) of the Faculty of Health Sciences, University of the Free State and Netball SA, the contact information of coaches were obtained from the Free State Netball Federation.

During the pilot study, a registered dietitian and a netball coach that is not involved in coaching of under 16 or under 18 netball players, completed the questionnaire to ensure that questions were relevant and fully understood. After the pilot study was conducted, small adaptions were made. The data obtained during the pilot study were not included in the final analysis of this study.

EvaSys software was used to design the online questionnaire and to collect the data. Coaches were informed about the study and invited to participate by means of an information letter sent via email. In order to encourage participation, a follow-up invitation was sent out to the coaches, one month later, while an incentive in the form of a coaching course and netball equipment was offered to a randomly selected coach who participated in the study.

4.2.3 VARIABLES MEASURED

The questionnaire was developed based on results from an in-depth literature review, questionnaires used in previous similar studies (Zinn et al., 2006; Schwartz, 2014; Horvath et al., 2014) as well as the researcher's experience in sports nutrition. Data relating to demographic background included team coached, age, ethnicity, gender, netball league, coaching level, number of years coaching, previous nutrition education or training received, access to healthcare professionals and facilities (such as gym and indoor courts) available. The sports nutrition knowledge questions consisted of

62 questions which were divided into six categories namely, general healthy eating (23 questions), fluid/hydration requirements (10 question), weight loss (14 questions), pre-training/ competition and during training/competition food intake (5 questions), recovery (6 questions) and supplement and ergogenic aid use (4 questions). Each question could be answered as “true”, “false” or “unsure”.

An overall knowledge score of 75% or more was considered to be adequate knowledge and less than 75%, inadequate knowledge (Torres-McGehee et al., 2012:206).

4.2.4 STATISTICAL ANALYSIS

Data were analysed using Statistical Analyses Software (SAS 9.4). Descriptive statistics were used to report on responses to all questions. Continuous variables are reported as medians, minimums, maximums and percentiles. Categorical variables are summarised as frequencies and percentages. Differences between groups were evaluated using the Chi-square test or the Fisher’s Exact Test for unpaired data. The level of significance was set at a *p-value* $\leq$ 0.05.

4.3 RESULTS

4.3.1 CHARACTERISTICS OF THE STUDY SAMPLE

Table 4.1 indicates the demographic characteristics of the netball coaches in the Free State.

Table 4.1: Demographic characteristics of u/16 and u/18 netball coaches in the Free State

	n	%
Netball team coached		
Under 16 netball team	15	44.1
Under 18 netball team	19	55.9
Netball league played		
1st League	27	81.8
2nd League	6	18.2
District		
Mangaung Metropolitan	9	26.5
Xhariep District	2	5.9
Lejweleputswa District	9	26.5
Thabo Mofutsanyane District	3	8.8
Fezile Dabi District	11	32.4
Gender		
Male	1	97.1
Female	33	2.9
Ethnic background		
Black African	3	8.8
White	30	88.2
Coloured	1	2.9
Employment status at the school where coaching		
Permanently employed	25	73.5
Not permanently employed	9	26.5
Coaching levels		
Pre-Level (Registered)	0	0
Level 1	21	61.8
Level 2	7	20.6
Level 3	2	5.9
Not registered	4	11.8
Education or training with regard to nutrition		
Formal training / education	10	29.4
No formal training / education	24	70.6
If trained - duration of the training		
Less than 5 hours	2	22.2
5 to 10 Hours	1	11.1
10 to 20 Hours	0	0
More than 20 hours	6	66.7
If trained, form of training		
Lectures	5	50.0
Part of another course	4	40.0
Practical workshop	1	10.0
Hours that the team train per week		
Less than 2 hours per week	0	0
2 to 3 Hours per week	0	0
3 to 4 Hours per week	8	24.2
4 to 5 Hours per week	10	30.3
More than 5 hours per week	15	45.5

Coaches (n=34) represented the five districts in the Free State province, with the Fezile Dabi District (Northern Free State District) having the most coaches participating (32.4%, n=11). Most of the coaches who participated in the study

coached under 18 netball teams (55.9%, n=19) and those teams that played in the first netball league (81.8%, n=27). Among the coaches, one was male and the rest female, with a median age of 32.5 years, ranging from 22 to 60 years. The duration of coaching experience of participants ranged between 1 to 38 years, with a median of 13 years of coaching experience. Most of the coaches (88.2%) were registered as coaches at Netball South Africa with 61.8% (n=21) being level 1 coaches, implicating a higher level of coaching skill and knowledge.

Only 29.4% (n=10) of coaches reported that they received any formal education or training with regard to nutrition. Of those who have received formal education or training, 66.7% (n=6) indicated that the education or training lasted longer than 20 hours and 22.2% (n=2) received training for less than 5 hours.

An average of 15 netball matches were being played during the netball season and almost half (45.5%, n=15) of the coaches reported that their team was training for more than 5 hours per week.

Table 4.2: Facilities and access to healthcare professionals available to netball coaches in the Free State

	n	%
Sporting facilities available		
Indoor court	1	2.9
Outdoor court	33	97.1
Gymnasium	13	38.2
Other	1	2.9
Access to healthcare professionals		
Sports nutritionist	1	2.9
Dietitian	1	2.9
Physician	4	11.8
Strength and conditioning trainer	11	32.4
Physiotherapist	8	23.5
Biokinetecist	1	2.9
No access health care professionals available	14	41.2

Table 4.2 provides a summary of the facilities and access to healthcare professionals available to coaches in the Free State. Outdoor courts (97.1%, n=33) were the most common type of facility available to teams, followed by a gymnasium (38.2%, n=13). Limited access to healthcare professionals was available, with 41.2% (n=14) of coaches indicating that no access to healthcare professionals was available. Strength

and conditioning trainers (32.4%, n=11) and a physiotherapist (23.5%, n=8) were the most frequent type of healthcare professionals available.

4.3.2 NUTRITION KNOWLEDGE

The overall median nutrition knowledge score obtained was 64.7%, confirming that as a group, the netball coaches in the Free State lack nutrition knowledge. Only four coaches demonstrated adequate nutrition knowledge by achieving a nutrition knowledge score above 75%. The lowest and highest knowledge scores obtained were 36.2% and 84.5%, respectively.

4.3.3 NUTRITION KNOWLEDGE AND DEMOGRAPHIC INFORMATION

Table 4.3 summarizes differences that were found between the total knowledge score of coaches according to the different demographic variables.

Table 4.3: Summary of coaches with adequate knowledge according to demographic variables

	n	%	P value
Netball team coached			
Under 16 netball team	2	13.3	*1.000*
Under 18 netball team	1	10.5	
Netball league played			
1st League	3	11.1	*1.000*
2nd League	1	16.7	
Coaching levels			
Pre-Level (Registered)	0	0	*0.334*
Level 1	2	9.5	
Level 2	1	14.4	
Level 3	1	25.0	
Not registered	0	0	
Coaching experience			
1 to 15 years	2	9.5	*0.627*
16 years and above	2	15.4	
Education or training with regard to nutrition			
Formal training / education	3	30.0	*0.067*
No formal training / education	1	4.2	

No significant differences were found between the total knowledge score of coaches for the following variables: team coached *(p = 1.000)*, netball league *(p = 1.000)*, coaching level *(p = 0.334)*, number of years coaching *(p = 0.627)* and nutrition education or nutrition training received *(p = 0.067).*

4.4 DISCUSSION

Only a few studies have been conducted to determine the nutrition knowledge of coaches, but to date, no study has been published that describes the nutrition knowledge of high school netball coaches in South Africa.

Different studies link various demographic factors with the level of nutrition knowledge amongst coaches. A relationship between nutrition knowledge, years of experience (Rockwell et al., 2001:177; Botsis and Holden, 2015:197; Salami et al., 2017:5), level of coaching (Juzwiak and Ancona-Lopez, 2004:228; Couture et al., 2015:329; Salami et al., 2017:5) and formal nutrition training received (Zinn et al., 2006:220; Cockburn et al., 2014: 1447; Salami et al., 2017:3) are described in literature. None of these variables however showed an influence on the nutrition knowledge demonstrated by coaches in this study. A larger sample size might however have been able to show these associations.

Rockwell et al., (2001:177) observed that coaches with more than 15 years of experience achieved significantly better nutrition knowledge scores compared to the ones with less than 15 years of experience. It was anticipated that knowledge scores would differ significantly between coaches, with more coaching experience and those with fewer years of being involved in coaching. In the current study, 9.5% of coaches with 1 to 15 years of experience and 15.4% of coaches with more than 16 years of coaching experience displayed sufficient knowledge. Coaches with more than 16 years of experience did not show to be more knowledgeable than those with less than 15 years of experience, which was unexpected. This was similar to studies by Botsis and Holden (2015:197) that described how coaches with only two years of experience had achieved the highest score. Additionally two coaches who indicated they had 12 years of experience achieving both the lowest and second highest scores, respectively. No association between coaching experience and nutritional knowledge was found (Botsis and Holden, 2015:197).

Couture et al. (2015:329) reported that level of coaching (coaches certified by the National Coaching Certification Program (NCCP)) had a positive association with nutrition knowledge. Because nutrition forms part of the current Netball South Africa's coaching level education program, similar findings were expected for the current study. Of the level 1, level 2 and level 3 coaches, 9.5%, 14.4% and 25.0% had

adequate knowledge, respectively. However, the coaches' level of coaching did not show a significant association with their nutrition knowledge. This can be due to the current coaching level education program not being informative enough or effective enough, and thus not preparing coaches well enough to give nutritional advice. The coaching level education program is not compulsory for school coaches, which could further play a role.

The results in this study show that under 16 and under 18 first or second netball league coaches in the Free State demonstrated inadequate knowledge with only four coaches achieving a nutrition knowledge score of more than 75%. Only 13.3% of under 16 coaches, 10.5% of under 18 coaches, 11.1% of coaches competing in the first league and 16.7% of coaches competing in the second league showed adequate knowledge.

The overall median nutrition knowledge score was 64.7%. This finding was similar to previous studies showing that coaches demonstrate a lack of nutrition knowledge (Rockwell et al., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn et al., 2006:224; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1447; Botsis and Holden, 2015:198; Couture et al., 2015:332; Salami et al., 2017:6). In a recent study by Salami et al. (2017:6), gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches from Lebanon obtained an average nutrition knowledge score of 51.1%, while Cockburn et al. (2014:1445) found that hockey and netball coaches with a level 2 and 3 United Kingdom coaching certificate (UKCC) only obtained an average score of 35.4%, which demonstrates a lack of sports nutrition knowledge. Gymnastics-, tennis-, swimming- and judo coaches from Brazil who participated in a study by Juzwiak and Lopez (2004:227) obtained the highest average score of 70%.

Only 29.4% of coaches indicated that they previously received nutrition education or training, which was similar to comparable studies with 38.7% of New Zeeland premier club rugby coaches (Zinn et al., 2006:220), 25.2% of hockey and netball coaches with a level 2 and 3 United Kingdom coaching certificate (Cockburn et al., 2014:1447) and 26.5% of gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches from Lebanon (Salami et al., 2017:3), respectively undergoing nutrition training. All the coaches in the current study indicated that they believe good nutrition can improve sports performance but still only a small percentage were trained in nutrition and had adequate nutrition knowledge.

New Zeeland premier club rugby coaches (Zinn et al., 2006:220), United Kingdom hockey and netball coaches (Cockburn et al., 2014: 1447) and Lebanon coaches (Salami et al., 2017:3) who completed formal nutrition education did outscore the ones who did not receive any form of formal nutrition training. Although it was just a small percentage, education with regard to nutrition did have an impact on the nutrition knowledge. There were no significant differences found between receiving nutrition education or training and the median nutrition knowledge score of the netball coaches in the Free State. Very few coaches received formal nutrition training and may therefore not have adequate knowledge or be adequately equipped to provide nutrition advice to athletes.

Once coaches complete the Netball South Africa coaching level education program, they qualify as a coach and no further compulsory continued professional development (CPD) is needed to maintain coaching level qualification. This absence of compulsory CPD for coaches might lead to training not being substantial enough to ensure a well-rounded knowledge of sports nutrition (Cockburn et al., 2014: 1449).

The ideal situation for an athlete striving for optimal performance is to have access to sports nutritionists and/or dietitians (Torres-McGehee et al., 2012:207). This, however, is not always possible. Sport and conditioning specialists (32.2%) were the most common healthcare professionals available to coaches, while only one coach had a dietitian available. The availability of funds or resources to hire dietitians or nutrition consultants for teams at high school is not always possible. Furthermore, almost half (41.2%) of the coaches had no access to any healthcare professionals. It can therefore be assumed that these coaches are the only source of health information for athletes, placing even more emphasis on the training of coaches. A realistic approach to improve nutrition knowledge and training is needed to ensure that coaches have the opportunity to gain sufficient knowledge or have adequate access to nutrition information (Cockburn et al., 2014:1444). Therefore, ongoing education programmes should be implemented to improve nutrition knowledge and to emphasise the importance of good nutrition for optimal health and performance (Arazi & Hosseini 2012:105; Zinn et al., 2006:214; Shriver et al., 2013:13).

Several research studies have concluded that nutrition education and intervention programmes can help improve knowledge and lead to better dietary habits of both

coaches and athletes (Sangeetha et al., 2014:977; Valliant et al., 2012:514; Schwartz, 2014:46; Daniel et al. 2016:576) and coaches (Jacob et al., 2016:1313).

The small sample size may have influenced the representativity of the results. It is also important to note that the nutrition knowledge score of 75% used as a cut-off value for adequate nutrition knowledge is based on a single reference and could be considered high. Knowledge could perhaps, in future studies, be graded into categories as an alternative way of judging the level of nutrition knowledge.

4.5 CONCLUSION

The under 16 and under 18 first or second netball league coaches in the Free State did not display sufficient nutrition knowledge in this study. Many coaches did not have any formal nutrition training. Coaches can therefore not be regarded as a reliable source to disseminate nutrition information, strategies and/or make nutrition recommendations to athletes. In order to gain a complete understanding of the issue, a larger sample size representing the whole country is needed. Nutrition education and training can assist in improving knowledge and lead to better dietary habits amongst athletes and coaches. Ongoing education programmes should, therefore, be implemented on a regular basis. Future research may want to compare knowledge across coaching domains and the effectiveness of different intervention programmes to provide insight into the development of coaches' nutrition knowledge.

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5. NUTRITION KNOWLEDGE AND ADVICE SHARED BY NETBALL COACHES IN THE FREE STATE

This chapter is written in article format and reports on the findings of data collected for this study according to the last two objectives of this study, which includes to determine the nutrition knowledge and practices of netball coaches that train under 16 and under 18 netball players in the first or second netball league in the Free State . This article has been written with the goal of submission to the Journal of International Society of Sport Nutrition (JISSN) and therefore the author guidelines of the JISSN (Addendum G) have been followed with the exception of the referencing style which is done according to the requirements of the Department of Nutrition and Dietetics, University of the Free State.

ABSTRACT

BACKGROUND: *Having access to sports nutritionists and/or dietitians is not always possible for athletes and coaches. Coaches play a major role in the nutrition practices, which affects the health and performance of athletes, therefore an increased emphasis should be placed on coaches' nutrition knowledge.* ***METHOD:*** *This descriptive study investigated the nutrition knowledge and advice practices of under 16 and under 18, first or second league netball coaches in the Free State. Forty-four coaches in the Free State were contacted and invited to participate in the study. A total of 34 coaches completed the online questionnaire, used to collect data.* ***RESULTS:*** *A median nutrition knowledge score of 64.7% was achieved by the coaches. Questions regarding pre-training/competition and during training/competition food as well as weight loss sections were answered the best, while questions in recovery and supplement and ergogenic aid sections were answered the poorest. More than half (55.9%, 19/34)) of coaches provide nutrition advice to their netball players. Those who gave advice did not obtain significantly (p = 0.313) better knowledge scores compared to those who did not give advice. Advice was mostly given regarding fluid/hydration (67.7%, 23/34)) and less often on supplements and ergogenic aids (14.7%, 5/34). Almost all of the coaches (82.3%) made use of some type of source to obtain nutrition information; with the internet (55.6%, 18/34) being the most popular source. Only a small percentage (21.9%, 7/34) utilised outside professionals to give*

nutrition advice to athletes. ***CONCLUSION:*** *Coaches did not display sufficient nutrition knowledge to be able to advise their athletes. Attention should be given to areas where knowledge was shown to be the poor (recovery and supplement and ergogenic aids). Education and training can assist in increasing knowledge which can help improve dietary advice practices of coaches.*

5.1 INTRODUCTION

The most important nutritional goal for young athletes, to ensure good health, growth and achieve optimal performance, is to consume a balanced diet (Purcell, 2013:200; Smith et al., 2015:2; Bean, 2017:231). Healthy nutrition behaviors and dietary practices are mostly learnt during the adolescent life stage, which can have an effect on an individuals' health for many years to follow (Hu et al., 2016:192; Todd et al., 2015:2319). This life stage thus serves as an ideal opportunity for athletes to adopt the basic principles of optimal nutrition (Manore et al., 2017:12).

Lack of knowledge (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstorm et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Shriver et al., 2013:12; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20) and poor dietary practices (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstorm et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Sangeetha et al., 2014:973; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Valliant et al., 2012:510; Shriver et al., 2013:13; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20) are prevalent amongst athletes, regardless of the fact that general guidelines for healthy eating and international sports nutrition recommendations are widely available (ADA/DC/ACSM, 2016:501).

Athletes rely on a variety of resources for nutrition advice, including physicians, dietitians, peers, teammates, family and the media (Rockwell et al., 2001:181; Juzwiak and Ancona-Lopez, 2004:224; Zinn et al., 2006:220; Cockburn et al., 2014:1447; Couture et al., 2015:328; Salami et al., 2017:4). It is however evident that coaches are one of the main sources of information for athletes (Hoogenboom et al., 2009:147; Hornstorm et al., 2011:113; Walsh et al., 2011:369; Torres-McGehee et al., 2012:209;

Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6). Coaches have direct and regular contact with athletes, and could therefore play an important role in their nutrition practices, health and performance (Zinn et al., 2006:214).

Coaches take up a position in a team sport that gives them the power and responsibility to make important decisions about many aspects of the team, which also provides them with a significant opportunity to influence young athletes (Cockburn et al., 2014:1443; Couture et al., 2015:332; Salami et al., 2017:6). Coaches are basically present at every training session and can observe and monitor nutrition practices before, during and after training sessions (Zinn, 2004:35).

Torres-McGehee et al. (2012:206), identified that nutrition information resources determined nutrition knowledge as well as confidence levels in terms of nutrition knowledge among athletes, coaches and trainers from different National Collegiate Athletic Association Division I, II, and III intuitions across the United States. Athletes (43%) were found to reach out to their coaches for nutrition advice (Torres-McGehee et al., 2012:208), which was similar to findings of other studies (Hornstorm et al., 2011:113; Walsh et al., 2011:369; Davar, 2012:121; Devlin and Belski, 2015:229; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:6). Therefore, in order to ensure that athletes remain healthy and perform at their optimal level, it is important that coaches provide accurate and correct information to athletes.

Several studies have concluded that coaches have poor nutrition knowledge and are not accurately informed to communicate nutrition information and/or give advice to athletes (Rockwell et al., 2001:184; Juzwiak and Ancona-Lopez, 2004:233; Zinn et al., 2006:224; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1447; Botsis and Holden, 2015:198; Couture et al., 2015:332; Jacob et al., 2016:1311; Salami et al., 2017:6), making them a less reliable nutrition resource for their athletes.

Of 168 New Zealand rugby coaches, 83.8% advised their athletes on nutrition (Zinn et al., 2006:217), which was similar to a recent study where 82.8% of 151 gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches from Lebanon reported to provide nutrition advice to their athletes (Salami et al., 2017:4). Lower engagement in providing nutrition advice were observed among United Kingdom and Canadian

coaches (57.1% and 60%, respectively) (Cockburn et al., 2014:1449; Couture et al., 2015:328).

Having access to sports nutritionists and/or dietitians would be the ideal situation for an athlete striving for optimal performance (Torres-McGehee et al., 2012:207). This, however, is not always possible. Sports dietitians are more often available to athletes that compete at a higher or more elite level, compared to high school and/or collegiate athletes (Devlin and Belski, 2015: 229). Having adequate funds or resources to hire dietitians or nutrition consultants for teams at high school or collegiate level, remains a challenge (Hornstorm et al., 2011:111).

Providing athletes and coaches with the opportunity to improve nutrition knowledge or to have adequate access to nutrition information would be a more practical approach (Cockburn et al., 2014:1444).

Therefore, the purpose of this study was to determine and describe the nutrition knowledge and advice practices of under 16 and under 18 first and second league netball coaches in the Free State.

5.2 METHODOLOGY

5.2.1 SUBJECTS

The study population included 44 coaches who were involved in the coaching of u/16 and u/18 netball players competing in the first or second league in the Free State in 2018. All 44 coaches were contacted and invited to participate in the study via email. Thirty-four of the coaches responded to the invitation and were willing to participate in the current study.

5.2.2 QUESTIONNAIRE DEVELOPMENT AND CONSENT

Results from an in-depth literature review, questionnaires used in previous similar studies (Zinn et al., 2006; Schwartz, 2014; Horvath et al., 2014) as well as the researcher's experience in sports nutrition were used as basis from which the questionnaire was developed. The sports nutrition knowledge section included 62 questions which were divided into six categories namely, general healthy eating (23 questions), fluid/hydration requirements (10 question), weight loss (14 questions), pre-training/ competition and during training/competition food intake (5 questions),

recovery (6 questions), as well as supplement and ergogenic aid use (4 questions). Each question could be answered as “true”, “false” or “unsure”.

Questions relating to the advice practices of coaches were open-ended questions on whether or not they share advice on nutrition, as well as the type of advice provided to athletes with regard to general healthy eating, fluid/hydration, weight loss, pre-training/ competition and during training/competition food intake, recovery and supplement and ergogenic aid use. Coaches were also asked about their perceived contribution, how often and what sources they use to obtain information and whether they made use of nutrition professionals or not.

5.2.3 PROCEDURE

Ethical approval was obtained from the Health Sciences Research Ethics Committee (HSREC 185_2016) of the Faculty of Health Sciences, University of the Free State, after which permission was sought from Netball South Africa in order to obtain the contact information of coaches from the Free State Netball Federation.

A registered dietitian and a netball coach, who were not involved in the coaching of u/16 or u/18 netball players at the time of data collection, were approached to complete the questionnaire as part of the pilot study in order to ensure that questions were relevant and fully understood. Small adaptions were made after the pilot study was conducted.

The questionnaire was designed and completed using EvaSys software. An invitation, accompanied by an information letter, was sent to all 44 coaches. One month after the initial invitation was sent out, a follow-up invitation was sent to the coaches in order to encourage participation. An incentive in the form of a coaching course and netball equipment was offered to a randomly selected coach who participated in the study.

Knowledge was considered to be adequate when an overall knowledge score of 75% or more was achieved (Torres-McGehee et al., 2012:206).

5.2.4 STATISTICAL ANALYSIS

Data were analysed by the Department of Biostatistics at the University of the Free State using Statistical Analyses Software (SAS 9.4). Descriptive statistics were used to report on responses to all questions. Medians, minimums, maximums and percentiles are reported for continuous variables, while frequencies and percentages

are used to report categorical variables. Differences between groups were evaluated using the Chi-square test or the Fisher's Exact Test for unpaired data. The level of significance was set at a *p-value* $\leq$ 0.05.

5.3 RESULTS

5.3.1 NUTRITION KNOWLEDGE

Only four coaches showed an adequate nutrition knowledge by achieving an overall knowledge score of above 75%, with scores ranging from 36.2% to 84.5%. Table 5.1 summarises the responses according to the different nutrition knowledge section and topics of concern can be identified from this summary. Overall the coaches achieved a median knowledge score of 64.7%.

Table 5.1: Correct responses to the different nutrition knowledge sections of netball coaches in the Free State

Sections	**Median score obtained (%) (n = 34)**
Overall	64.7
Healthy eating	67.2
Fluid/hydration	65.0
Weight loss	75.0
Pre- training/competition and during training/competition food	80.0
Recovery	50.0
Supplements and ergogenic aids	50.0

Table 5.2 summarises the various categories and indicates the questions with more than 50% of questions answered incorrectly as well as the questions with more than 90% of answers correct.

Table 5.2: Questions answered incorrectly and correctly by coaches

More than 50% of coaches answered the following questions incorrectly		
		Percentage (%)
Healthy eating section:	The glycaemic index refers to the rate carbohydrates is released in to the blood (T)	61.76
	Protein is the primary source of energy for an athlete (F)	64.71
	Dry beans, peas, lentils and soy are good sources of protein but should be eaten only once a week (F)	70.59
	A glass of full cream milk contains more protein than a glass of low fat milk (F)	58.83
	Fat intake should be less than 15% of total daily energy intake (F)	79.41
Fluid/hydration section:	In exercise lasting longer than 1 hour, sport drinks are better to drink than water (T)	73.53
	Using thirst sensation in young athletes as a method to avoid dehydration is a good strategy (F)	52.94
	The percentage of carbohydrates in sport drinks should be 4-8% for best absorption (T)	67.65
	Weighing players before and after training is a good way to determine each individual's fluid loss (T)	79.41
Weight loss section:	Eating carbohydrates makes you gain weight (F)	58.82
Pre-training/competition and during training/competition food section:	The pre-exercise or competition meal should be eaten 6 or more hours before exercise or competition (F)	58.82
Recovery section:	The best time to replace glycogen is 3-4 hours after exercise (F)	84.84
	High and moderate GI, carbohydrate-rich foods are good choices directly after exercise (T)	79.42
	Combining carbohydrate and protein intake after exercise can slow down recovery and it is thus better to eat only carbohydrates after exercise (F)	76.47
More than 90% of coaches answered following questions correctly		
		Percentage (%)
Healthy eating section:	The key principle to healthy eating for a physical active person is to include a variety of food groups in their daily diet (T)	100.00
	Good nutrition is key to ensure optimum performance (T)	100.00
	Food consist of the same amounts of protein, carbohydrates and fat (F)	97.06

	When food is consumed and nutrients are broken down in the body, a certain amount of energy is provided (T)	96.97
	Good sources of calcium includes milk and milk products (T)	94.12
	Calcium is not essential for strong bones (F)	94.12
	Iron deficiency can cause: tiredness, shortness of breath, poor appetite and lack of concentration (T)	97.06
	Spinach and broccoli are good plant sources of iron (T)	91.18
Fluid/hydration section:	Dehydration will not have a negative effect on performance (T)	100.00
	Small amounts of water should be drank frequently during exercise rather than larger amount of fluid less frequently (T)	97.06
	In order to improve endurance one caffeinated energy drink, such as Red Bull, is a good drink to have 30 minutes before exercise (F)	94.12
Weight loss section:	Rapid weight loss methods is the best way to lose weight (F)	97.06
	The best way to lose weight is to skip meals and only eat 2 big meals per day (F)	97.06
Pre-training/competition and during training/competition food section:	It is not necessary to take regular drink breaks during exercise (F)	94.12
Supplements and ergogenic aids section:	Iron supplements should be taken under the supervision of a medical/ nutrition expert when a player feels extremely tired and is pale (T)	91.18

*F – False *T - True

5.3.2 NUTRITION ADVICE

All coaches believed that good nutrition practices can improve sports performance and over half (55.9%, n=19) of the coaches reported that they provide advice to their netball players. Reasons for not giving advice included: “not confident with my level of nutrition knowledge” (77.8%, n=7) and “someone else provides the athletes with nutrition advice” (22.2%, n=2).

Only 15.8% of the coaches who indicated that they imparted advice to their athletes obtained a knowledge score of above 75%. No significant difference ($p = 0.313$) in knowledge scores were found between those coaches who gave advice and those who did not give advice.

Table 5.3 shows that coaches shared advice on different nutrition topics.

Table 5.3: Topics covered when giving advice to players

Topic	n	%
Healthy eating	21	61.8
Fluid/hydration	23	67.7
Weight loss	12	35.9
Pre-training/competition food	10	29.4
During training/competition food	11	32.4
Recovery	14	41.2
Supplements and ergogenic aids	5	14.7

5.3.3 NUTRITION INFORMATION SOURCES

Overall, 82.3% of coaches indicated that they read about nutrition related issues. As indicated in Table 5.4, only approximately twenty percent (17.7%, n=6) reported that they never read about nutrition related issues. The majority of coaches consulted the internet (55.6%, n=18) to obtain nutrition information.

Table 5.4: Sources frequently used to obtain nutrition information

	n	%
Frequently read about nutrition related issues		
Never	6	17.7
Weekly	2	5.9
Monthly	11	32.4
Six monthly	11	32.4
Yearly	4	11.8
Source of nutrition information		
Internet	18	55.6
Popular magazines	6	18.2
Sports magazines	5	15.2
Healthcare Professional (sports nutritionist/dietitian, physician, strength and conditioning trainer, physiotherapist and/or biokineticist)	3	9.1
Sponsors	1	3.0

No significant difference (*p = 0.494*) between the median knowledge score of coaches who read about nutrition compared to those who do not read about nutrition were found.

5.3.4 USE OF PROFESSIONALS

Most of the coaches (78.1%, n=25,) have never made use of a professional to give nutrition advice to their players. Of the small percentage (21.9%, n=7) that did utilise a professional, most used doctors (57.1%, n=4), followed by dietitians (42.9%, n=3), sports nutritionists (28.6%, n=2), strength and conditioning trainers (28.6%, n=2), and physiotherapists (14.3%, n=1).

When asked why coaches did not make use of outside professionals, 19 (55.9%) of participants reported that it is too expensive to make use of a professional, while 6 (17.7%) reported that professionals are not available to give advice. One (2.9%) coach felt that his/her own nutrition knowledge was sufficient.

Among the coaches providing advice on nutrition, 23.5% (n = 4) made use of outside professionals. No significant difference (*p = 1.000*) in advice shared was found between the coaches who made use of outside professionals and those who did not make use of outside professionals.

5.4 DISCUSSION

Inadequate dietary practices (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Sangeetha et al., 2014:973; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Valliant et al., 2012:510; Shriver et al., 2013:13; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20) and lack of knowledge are prevalent not just amongst coaches, but athletes as well (Hoogenboom et al., 2009:144; Azizi et al., 2010:107; Hornstrom et al., 2011:112; Walsh et al., 2011:367; Arazi and Hosseini, 2012:102; Spendlove et al., 2012:1872; Torres-McGehee et al., 2012:206; Shriver et al., 2013:12; Alaunyte et al., 2015:3; Devlin and Belski, 2015:226; Montecalbo and Cardenas, 2015:46; Manore et al., 2017:20).

One of the main findings from the current study was that coaches achieved a low median nutrition knowledge score of 64.7%. A previous study (Torres-McGehee et

al., 2012:206) used a minimum knowledge score of 75% when evaluating the level of nutrition knowledge of coaches, thus implying that coaches in the Free State did not display adequate nutrition knowledge to make recommendations or give nutritional advice to their athletes.

The lowest nutrition knowledge score achieved was 36.2% while the highest score was 84.5%, with only four coaches achieving a percentage above 75%. In a recent study (Salami et al., 2017:6), 151 gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches from Lebanon obtained an average nutrition knowledge score of 51.1% which was lower than the netball coaches from the Free State. In other studies, the coaches' nutrition knowledge scores ranged from 35% to 70% (Rockwell et al., 2001:177; Juzwiak and Ancona-Lopez 2004:227; Zinn et al., 2006:221; Torres-McGehee et al., 2012:209; Cockburn et al., 2014:1445; Botsis and Holden, 2015:197; Couture et al., 2015:328; Salami et al., 2017:4), with the gymnastics-, tennis-, swimming- and judo coaches from Brazil who participated in the study by Juzwiak and Lopez (2004:227) obtaining the highest average score of 70%.

New Zeeland premier club rugby- , United Kingdom hockey and netball- and Lebanon gymnastics-, tennis-, swimming-, basketball-, football- and judo coaches (Zinn et al., 2006:219; Cockburn et al., 2014: 1446; Salami et al., 2017:3) answered significantly more questions correctly in both nutrient and recovery categories, followed by fluid, weight control and supplements. In other studies (Rockwell et al., 2001:178; Torres-McGehee et al., 2012:210), the coaches achieved their highest nutrition knowledge score in the supplements category and lowest score in the macro- and micronutrient category. Couture et al. (2015:329) further, pointed out that "leanness and non-leanness sport" coaches from Canada seemed to understand hydration and weight management better than the role of carbohydrates and protein.

All questions on weight control were answered incorrectly by the coaches in the study by Salami et al. (2017:3), which was similar to findings in other studies (Zinn et al., 2006:219; Cockburn et al., 2014:1446). Juzwiak and Ancona-Lopez (2004:225) reported a clear knowledge deficit related to weight control and strategies concerning pre-training, training/competition, and post-training. While in the current study "pre-training/competition and during training/competition food" and "weight loss" questions were mostly understood well. More than 90% of the coaches correctly identified that

rapid weight loss methods is not the best way to lose weight and that the best way to lose weight is not to skip meals and only eat two big meals per day.

In the current study, over half of the coaches provide advice to their netball players (55.9%, n=19), while 44.1% (n=15) of the coaches did not provide advice. This finding was in line with some of the lower percentage of advice practices observed among the United Kingdom and Canadian coaches (57.1% and 60%, respectively) (Cockburn et al., 2014:1449; Couture et al., 2015:328). Of the 168 New Zealand coaches, 83.8% of the coaches shared nutrition advice (Zinn et al., 2006:217), which was similar to a recent study where 82.8% of coaches in Lebanon participated in nutrition advice practices (Salami et al., 2017:4).

There are numerous reasons why coaches may not offer nutrition advice to their athletes. We anticipated that the netball coaches might not offer advice on nutrition, firstly because coaches may not have the confidence to give nutrition advice, as they have become increasingly aware that their nutrition knowledge is not up to standard. Secondly, because they might begin to understand the importance of nutrition and the role it has on an athlete's overall health and performance, leading to the use of external professionals on a more frequent basis. Thirdly, we expected that coaches would have no time to advise athletes on nutrition (Cockburn et al., 2014:1445; Salami et al., 2017:2).

We found that coaches (77.8%) did not feel confident in their level of knowledge and only 22.2% indicated that someone else will provide the athlete with nutrition advice. Surprisingly, none of the coaches indicated that they have no time to give nutrition advice.

All coaches indicated that they believe good nutrition can increase athletes' performances, even though it was expected that some might think nutrition is not that important for an athlete's performance.

Coaches imparted advice mainly on healthy eating (61.8%) fluid/hydration (67.7%), weight loss (35.9%), pre-training/competition food (29.4%), during training/competition food (32.4%), recovery (41.2%) and supplements and ergogenic aids (14.7%). Literature showed the same tendency (Rockwell et al., 2001:179; Juzwiak and

Ancona-Lopez, 2004:226,227; Zinn et al., 2006:219; Cockburn et al., 2014:1445; Couture et al., 2015:330; Salami et al., 2017:4).

It is evident that coaches frequently recommended the use of supplements to athletes (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:227), but this was not reported in studies by Zinn et al. (2006:219), Cockburn et al. (2014:1445), Couture et al. (2015:330) and Salami et al. (2017:4). Only a few netball coaches (14.7 %) in the Free State gave advice on supplements. This finding is encouraging because coaches achieved the lowest median nutrition knowledge score on this topic and the lowest number of coaches gave advice on this topic. This can be an indication that the coaches decided not to risk giving inaccurate advice on a topic they did not feel knowledgeable about. Furthermore, this might also give athletes the opportunity to make use of information from more reliable sources.

Coaches in the current study achieved a median knowledge correct score of 65.0% for hydration. Other coaches have shown to understand the importance of hydration (Juzwiak and Ancona-Lopez, 2004:227; Zinn et al., 2006:219; Cockburn et al., 2014:1449; Couture et al., 2015:332; Salami et al., 2017:4). But regardless of the fact that coaches responded correctly to most of the questions in this section, a clear gap was identified between the nutrition knowledge of the coaches and their advice practices in relation to hydration issues. One would expect that the netball coaches in the current study, just like coaches in a study by Rockwell et al. (2001:178), would correctly identify that thirst did not best indicate the need for hydration. They were also unable to indicate the percentage of carbohydrates in sport drinks that is best for absorption (4-8%). A large percentage of coaches (67.7%) gave advice on fluids/hydration and it may be anticipated that they are providing advice in an area where they think they are knowledgeable, but in fact they are not.

Coaches displayed adequate knowledge on the weight loss topic (75.0%). This finding was the opposite of findings from previous studies showing that all trainers answered the questions regarding weight control issues inaccurately (Zinn et al., 2006:222; Salami et al., 2017:4)

Many athletes have the desire to lose or gain weight in order to reach or maintain a competitive weight (Bean, 2017:185). Different weight managing or monitoring

behaviours have been observed among athletes, including weighing and assessing body fat composition (Rockwell et al., 2001:179). The different weight loss strategies that coaches recommend to their athletes include restricting food intake (Rockwell et al., 2001:179; Juzwiak and Ancona-Lopez, 2004:231), performing extra workouts (Rockwell et al., 2001:179) or harmful weight loss practices such as wearing plastic or wool clothes, use of saunas and fasting for longer than four hours at a time (Juzwiak and Ancona-Lopez, 2004:231), which is concerning.

It is reassuring to note that more than 90.0% of the netball coaches in the current study correctly indicated the statements “rapid weight loss methods is the best way to lose weight” and “the best way to lose weight is to skip meals and only eat 2 big meals per day” as false.

Several studies found that coaches who provide advice, obtained significantly higher nutrition knowledge scores than those who did not give advice (Zinn et al., 2006:222; Salami et al., 2017:3). These findings were not observed in our study as well as the study by Cockburn et al. (2014:1446), where no significant difference in nutrition knowledge scores were found between coaches who gave advice and those who did not.

Majority of coaches (82.3%) make use of a variety of information sources to obtain information on nutrition. The internet (55.6%) is one of the most common sources of nutrition information that coaches utilise, followed by popular magazines (18.2%) and sport magazines (15.2%). Despite the availability of sources like the internet and magazine articles, the trustworthiness of the information remains questionable and should be verified before the information is used (Cockburn et al., 2014:1443). A small percentage of coaches made use of professionals to obtain nutritional advice or information. Only 9.1% of the coaches indicated that they made use of healthcare professionals.

It is of concern that only a small percentage (21.9%) of the coaches made use of outside professionals to provide their team with advice on nutrition. Of these coaches, most made use of doctors (57.1%) followed by dietitians, sports nutritionists, strength and conditioning trainers and physiotherapists. Furthermore, many coaches did not make use of outside professionals because it is too expensive, or they indicated that

no professionals are available to give advice. It is preferred that coaches who are not adequately trained in providing nutrition advice or education seek such assistance from trained professionals.

The small sample size of this study is a disadvantage that resulted in less information than what was planned for. Also, the small sample size made it difficult to compare results with that of other similar studies. Future studies could consider a larger geographic area and include a larger sample size.

5.5 CONCLUSION

In an ideal setting, athletes and coaches should have access to sports nutritionists and/or dietitians, however, this is not always possible. If coaches, therefore, do not have access to or are not making use of outside professionals, it is import that these coaches obtain adequate knowledge to impart nutrition advice. The coaches in the current study unfortunately did not display sufficient nutrition knowledge. Coaches have the power and responsibility to make important decisions and influence young athletes. Nutrition education and training can assist in increasing knowledge amongst coaches and possibly lead to improved dietary advice practices. Empowerment of coaches to provide coaches to provide adequate nutrition education should also be investigated as access to nutrition experts is not always available. Furthermore, coaches should be encouraged to advise and refer athletes to professionals that specialise in nutrition, like a sports nutritionist and/or dietitian.

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6. CONCLUSION AND RECOMMENDATION

6.1 INTRODUCTION

This research study investigated the demographic background, facilities available, nutrition knowledge and advice practices of coaches that train under 16 and under 18 netball players in the first or second netball league in the Free State province.

The identification of coaches' demographic background and facilities available, as well as their level of knowledge and the nutrition advice they share with their netball players provide important baseline information to develop nutrition education and training programmes, to assist in improving nutrition knowledge, which in turn can lead to better dietary habits amongst athletes and coaches.

In an ideal setting, sports nutritionists and/or dietitians should be available to athletes and coaches, however, this is not always possible and affordable. It is evident that athletes rely mainly on coaches for nutrition advice and coaches in most cases serve as a primary source of nutrition information for athletes (Valliant et al., 2012:513; Couture et al., 2015:326; Botsis and Holden, 2015:197; Hoogenboom et al., 2009:147).

6.2 EVALUATING NUTRITION KNOWLEDGE AND NUTRITIONAL ADVICE PRACTICES OF COACHES

As seen globally in various sport types, the coaches in the current study did not display sufficient nutrition knowledge and can therefore not be regarded as a reliable source of nutrition information to provide nutrition information, plan intervention strategies and/or make nutrition recommendations to athletes.

Only four coaches out of a total of thirty-four, achieved an adequate nutrition knowledge score of above 75%, with the median knowledge score being 64.7%. It is important to note that this score is based on a single reference and a score of 75% could be considered high. Knowledge could perhaps, in future studies, be graded into categories as an alternative way of judging the level of nutrition knowledge.

Questions in the "pre- training/competition and during training/competition food" and "weight loss" sections were understood best by the netball coaches compared to the

other sections (healthy eating, fluid/hydration, recovery and supplements and ergogenic aids) in the questionnaire.

Over half (55.9%) of the coaches reported to provide advice on healthy eating, fluid/hydration, weight loss, pre-training/competition food, during training/competition food, recovery and supplements and ergogenic aids. No significant difference in knowledge scores between those coaches who gave advice and those who did not give advice were however found.

The exact advice provided by the netball coaches to their athletes is beyond the scope of this study, but if it is assumed that the coaches' advice is based on the nutrition knowledge score they obtained in the study, it casts doubt on the accuracy of the information provided.

Of concern was the fact that all of the coaches in the study believed that good nutrition practices can improve sport performance but still the majority did not:

- have any formal nutrition education and training,
- have access and/or do not make use of healthcare professionals, or
- make use of reliable information sources.

Only a small percentage (29.4%) of the coaches indicated to have received formal education or training in nutrition, but regardless of whether they received training/education or not, no difference in nutrition knowledge was observed.

No further compulsory continued professional development is needed to maintain coaching level qualification after a coach has completed the Netball South Africa coaching level education programme when they qualify as a coach. It is therefore the coach's own responsibility to stay up to date or improve their knowledge. Furthermore this absence of compulsory continued professional development for coaches might lead to training not being substantial enough to ensure a well-rounded knowledge of sports nutrition (Cockburn et al., 2014: 1449).

More than half (58.8%) of the coaches had access to support from a healthcare provider, with 41.2% of coaches having no healthcare professional available. The

most common types of healthcare professional available included strength and conditioning trainers (32.4%) and a physiotherapist (23.5%).

The majority of coaches (78.1%) have never made use of a professional to provide advice on nutrition to their players, with reasons for not using a professional indicated as either being too expensive to use a professional or no professionals being available to provide advice to their players. The small percentage (21.9%) that did use a professional, often utilised professionals that may not be knowledgeable to deliver nutrition advice or professionals to whom nutrition did not fall in their scope of practice.

Almost all of the coaches (82.3%) read about nutrition related issues. The internet (55.6%) was the most popular source used to obtain nutrition information. Adequate knowledge and skill are, however, required to evaluate such sources for credibility. It was anticipated that those who read about nutrition related issues would display a better nutrition knowledge, however that was not the case. Coaches who read about nutrition information did not necessarily show better nutrition knowledge scores compared to those who did not read about nutrition information.

Where coaches and athletes, do not have access to and/or do not make use of outside professionals, it is of utmost importance that these coaches possess adequate knowledge to impart accurate nutrition advice to their athletes. This can be done through nutrition education, training and/or by making use of reliable information sources.

It is clear from the current study that nutritional practices are not always according to guidelines and recommendations. Often, common nutrition misconceptions exist amongst coaches. In addition to this, making use of unreliable information sources, not having access to or not making use of outside professionals and/or not receiving nutrition education, further contribute to the problem of lack of a knowledge and poor nutrition advice practices.

Ongoing nutrition education and training programmes (implemented on a regular basis) can assist in increasing knowledge amongst coaches and possibly lead to improved dietary advice practices. Furthermore, coaches should be encouraged to advise and refer athletes to professionals that specialise in nutrition, like a sports nutritionist and/or dietitian.

6.3 RECOMMENDATIONS

Evaluating the nutrition knowledge and accuracy of nutritional advice provided by coaches, will help dietitians and nutritionists identify knowledge gaps in nutrition amongst coaches, which will assist in the development and implementation of appropriate intervention strategies.

The following adjustments to this study are recommended for future research:

- To determine the sports nutrition knowledge of different groups. These groups may include athletes, coaches involved with a variety of sports and other health care professionals like sport and conditioning coaches, physiotherapist, etc.
- To evaluate the content of nutrition education and training that coaches received.
- To evaluate the exact advice on nutrition that coaches are sharing with their athletes.

Future research could include:

- The research of sports nutrition knowledge and advice practices of coaches. By identifying knowledge gaps and/or misconceptions in nutrition amongst coaches, through evaluating the nutrition knowledge and accuracy of nutritional advice provided by coaches, will help assist in the development and implementation of intervention strategies. Ongoing education programmes should, therefore, be implemented on a frequent basis.
- The effectiveness of current intervention programmes. Literature supports the fact that nutrition education and intervention programmes can assist in the improvement of knowledge and lead to better dietary habits amongst athletes and coaches (Sangeetha et al., 2014:977; Valliant et al., 2012:514; Schwartz, 2014:46; Daniel et al. 2016:576; Jacob et al., 2016:1313).
- The development and creation of different nutrition education programmes and interventions aimed at different sports. Findings of the current study could also be used to advocate for funding towards nutrition education programmes of netball coaches, since often there is not access to or funding for such programmes, particularly in lower levels of sporting participation.

- Evaluating the need and practical application (by national sporting bodies like Netball South Africa) for compulsory continued professional development after obtaining a coaching level qualification, in order to stay up to date with the latest nutrition information and to increase sports nutrition knowledge.
- Including a larger sample size representing different sporting codes, levels and coaches from the whole country. This will help to gain a complete understanding of their knowledge. Although only a small sample size were used in the current study, this study serves as an opportunity for further research. A larger sample size might be powered better to show associations.

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ADDENDUM A

Letter of approval from the Health Sciences Research Ethics Committee, Faculty of Health Sciences, University of the Free State

UFS·UV

IRB nr 00006240
REC Reference nr 230408-011
IORG0005187
FWA00012784

01 March 2017

MS K MOSTERT
DEPT OF NUTRITION AND DIETETICS
FACULTY OF HEALTH SCIENCES
UFS

Dear Ms K Mostert

HSREC 185/2016 (UFS-HSD2016/1493)
PROJECT TITLE: NUTRITION KNOWLEDGE AND NUTRITIONAL ADVICE PRACTICES OF NETBALL COACHES IN THE FREE STATE

1. You are hereby kindly informed that, at the meeting held on 28 February 2017, the Health Sciences Research Ethics Committee (HSREC) approved this protocol after all conditions were met.
2. The Committee must be informed of any serious adverse event and/or termination of the study.
3. Any amendment, extension or other modifications to the protocol must be submitted to the HSREC for approval.
4. A progress report should be submitted within one year of approval and annually for long term studies.
5. A final report should be submitted at the completion of the study.
6. Kindly use the **HSREC NR** as reference in correspondence to the HSREC Secretariat.
7. The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 [for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite). Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

Yours faithfully

DR SM LE GRANGE
CHAIR: HEALTH SCIENCES RESEARCH ETHICS COMMITTEE

Health Sciences Research Ethics Committee
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ADDENDUM B

Letter of approval from Netball South Africa

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info@netball-sa.co.za
Park Street Arcadia, 0038
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Pretoria, 0028

2 November 2016

Karla Mostert

Email: mostertkarlaa@gmail.com

Dear Ms Mostert

NSA have reviewed your request to conduct research involving the U/16 and U/18 first or second netball league coaches in the Free State Province to evaluate their nutritional knowledge and practices.

NSA believe this research study will be beneficial not only to Free State coaches and athletes, but Netball South Africa Coaches and athletes in general.

You have NSA's approval and permission to conduct your research to assist coaches, athletes and health professionals to develop and implement better nutritional training programmes.

We wish you success in your research.

Regards,

Blanche de la Guerre
Chief Executive
blanche@netball-sa.co.za
083 447 1774

ADDENDUM C

Information letter to invite netball coaches to participate in the study

Nutrition knowledge and nutritional advice practices of netball coaches in the Free State

Dear Coach

My name is Karla Pretorius (née Mostert) and I am doing my Masters degree in Dietetics at the University of the Free State. I am doing research on the nutrition knowledge and nutritional advice practices of u/16 and/or u/18 first and second league netball coaches in the Free State.

If you are coaching netball for an u/16 and/or u/18 first or second league team in the Free State, I would like to invite you to participate in my study.

The study entails an online questionnaire, which will take about 20 minutes to complete. You can complete it anonymously and no foreseeable risks or harm is expected from participating in this study.

Participation is voluntary and you may withdraw at any time. If you wish not to participate, your choice will result in no penalty or loss of benefits to which you are otherwise entitled

The purpose of the study is:

- To describe the demographic background and facilities available to coaches.
- To determine the knowledge of coaches regarding sports nutrition.
- To determine the practices of coaches with regard to providing nutritional advice to their team.

Several studies have shown that coaches are one of the primary sources of nutritional information for young athletes (Couture et al., 2015:326; Botsis and Holden, 2015:197; Hoogenboom et al., 2009:147) and they play an influential role in athletes' nutrition practices.

The findings from this study may assist coaches, athletes and health professionals to develop and improve nutrition training programmes.

Lucky draw

Although the research is anonymous, coaches who voluntarily provide their contact details will automatically be entered into a lucky draw. The name of one coach will be randomly

drawn to win a netball coaching course and netball equipment. The coaching course will be presented by Karla Pretorius (née Mostert), Spar Protea and Sunshine Coast Lightning netball player.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS (Tel: +27(0) 51 405 2812) if you have questions about your rights as a research subject.

Karla Pretorius (née Mostert)

082 922 6336

mostertkarlaa@gmail.com

ADDENDUM D

Consent to participate in a research study

Nutrition knowledge and nutritional advice practices of netball coaches in the Free State

I have been invited to participate in a research study conducted by Karla Mostert, a Masters student from the Department of Nutrition and Dietetics, University of the Free State to investigate the nutrition knowledge and nutritional advice practices of 0/16 and 0/18 first or second netball league coaches in the Free State. The findings from this study may assist nutritional professionals to develop and implement better nutrition training programmes.

I have been informed about the study by Karla Mostert from the University of the Free State.
I have been informed that participation is voluntary and that no compensation for participation is applicable.
I may contact the Secretariat of the Health Research Ethics Committee of the Faculty of Health Sciences, University of the Free State, at 051 405 2812, if I have any questions about my rights as a research subject.
My participation in this research is voluntary, and I will not be penalized or lose benefits if I refuse to participate or decide to terminate participation.
By completing the rest of this questionnaire, I agree to participate. The research study, including the above information has been described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

ADDENDUM E

Questionnaire: Nutrition knowledge and nutritional advice practice of coaches in the Free State

Nutrition knowledge and nutritional advice practices of netball coaches in the Free State

NAME: _____(if you would like to qualify for a lucky draw)

DATE: DD MM YYYY

EMAIL: _____(if you would like to qualify for a lucky draw)

You have been asked to participate in this study. Please note that by completing this questionnaire you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from this study at any given moment during the completion of the questionnaire. The results of the study may be published.

Instructions

Please read each question carefully! Answer each question honestly and to the best of your ability with what you believe to be is the correct answer. Please don't guess!

Please select only **one** answer from each question unless otherwise indicated.

Part I: Demographics

1. Date on which questionnaire is completed?

DD	*MM*	*YYYY*

2. How old are you?

years

3. Date of birth

DD	*MM*	*YYYY*

4. Gender

Female	*Male*

5. What is your ethnic background?

a. Black African	
b. White	
c. Coloured	
d. Asian	
e. Other (please specify):	

6. Are you permanently employed as a teacher at the school you coach?

a. Yes	
b. No	

7. What is your coaching level?

a. Pre-Level (Registered)	
b. Level 1	
c. Level 2	
d. Level 3	

e. Not registered	

8. For how long have you been involved In netball coaching? ____ years

9. Have you received any formal education or training with regards to nutrition?

a. Yes	
b. No	

If "No" please continue at Question 12. If "Yes" please proceed.

10. What was the length of the training?

a. Less than 5 hours	
b. 5 to 10 hours	
c. 10 to 20 hours	
d. More than 20 hours	

11. What was the training made up of?

a. Lectures	
b. Part of another course	
c. Practical work shop	
d. Other (Please specify):	

12. How many netball matches does your team play per season?

13. How many hours does your team train per week?

a. Less than 2 hours per week	
b. 2 to 3 hours per week	
c. 3 to 4 hours per week	
d. 4 to 5 hours per week	
e. more than 5 hours per week	

14. What sporting facilities do you have available for your team? (Please tick as many options as necessary)

a. Indoor court	
b. Outdoor court	
c. Gymnasium	
d. Other (Please specify):	

15. Do you have any healthcare support available? (Please tick as many options as necessary)

a. Sport nutritionist	
b. Dietitian	
c. Doctor	
d. Strength and conditioning trainer	
e. Physiotherapist	
f. No healthcare support available	
g. Other (Please specify):	

Part II: Nutrition Knowledge

Healthy eating:	True	False	Unsure
16. The key principle to healthy eating for a physical active person is to include a variety of food groups in their daily diet.			
17. Good nutrition is key to ensure optimum performance			
18. Food consist of the same amounts of protein, carbohydrates and fat.			
19. When food is consumed and nutrients are broken down in the body, a certain amount of energy is provided.			
20. Athletes need to eat more food to provide energy to balance out the increased energy demands of training, and to maintain their body weight and overall growth and health.			
21. In females consuming too little energy cannot lead to disturbed eating patterns, menstrual disorders and low bone mineral density.			
22. The aim for optimal performance is to eat as little as possible fat.			
23. The main dietary source of energy for the human body is fat.			
24. Glucose is stored in the liver and muscles as glycogen.			
25. Carbohydrates are not a fundamental nutrient for mental performance.			
26. In addition to providing energy, carbohydrates also help spare protein.			
27. The glycemic index refers to the rate carbohydrates is released in to the blood.			
28. Vegetables and fruits are not rich in vitamins, minerals and fibre.			
29. Nutrients in vegetables can't be destroyed if it is cooked.			
30. Fiber in the diet may help decrease constipation, decrease blood cholesterol levels and protect against heart diseases, diabetes and cancer.			
31. Protein is the primary source of energy for an athlete.			
32. Sources of high-quality protein includes lean meats, poultry, eggs, legumes, and low-fat dairy products.			
33. Dry beans, peas, lentils and soy are good sources of protein but should be eaten only once a week.			
34. Good sources of calcium includes milk and milk products.			

35. A glass of full cream milk contains more protein than a glass of low fat milk.			
36. Calcium is not essential for strong bones.			
37. Protein is vital for growth and repair of tissue as well as to regulating many metabolic pathways.			
38. Vegetable fats such as sunflower, olive or canola oils and spreads are just as unhealthy as butter.			
39. Fat intake should be less than 15% of total daily energy intake.			
40. Iron needs are lower in female athletes than in male athletes.			
41. Iron deficiency can cause: tiredness, shortness of breath, poor appetite and lack of concentration.			
42. Spinach and broccoli are good plant sources of iron.			
43. Vitamin C reduce the absorption of iron.			
44. Vitamins are involved in metabolic reactions that produces energy.			

Fluid/hydration:	**True**	**False**	**Unsure**
45. In exercise lasting longer than 1 hour, sport drinks are better to drink than water.			
46. Using thirst sensation in young athletes as a method to avoid dehydration is a good strategy.			
47. Dehydration will not have a negative effect on performance.			
48. Small amounts of water should be drank frequently during exercise rather than larger amount of fluid less frequently.			
49. The percentage of carbohydrates in sport drinks should be 4-8% for best absorption.			
50. Fluid loss of 1% body weight can reduce performance, influence cognitive function and aerobic performance.			
51. Weighing players before and after training is a good way to determine each individual's fluid loss.			
52. In order to improve endurance one caffeinated energy drink, such as Red Bull, is a good drink to have 30 minutes before exercise.			
53. Urine colour is not a good indicator of hydration status.			
54. Urine colour should be darker than usual before exercise for optimal performance.			

Weight loss:	True	False	Unsure
55. When energy intake is the same as energy expenditure, energy balance occurs.			
56. Rapid weight loss methods is the best way to lose weight.			
57. Eating carbohydrates makes you gain weight.			
58. The best way to lose weight is to skip meals and only eat 2 big meals per day.			

Pre-training/competition and during training/competition food:	True	False	Unsure
59. Food that is easily digestible and moderate to low GI are good food options to eat before a training session or competition.			
60. Food high in fat should be eaten before the event, To reduce the risk for any gastrointestinal problems during an event.			
61. The pre-exercise or competition meal should be eaten 6 or more hours before exercise or competition.			
62. It is not necessary to take regular drink breaks during exercise.			
63. Foods high in carbohydrates and low in fat is good food options to snack on between events.			

Recovery:	True	False	Unsure
64. After an exercise session lasting an hour, replacing carbohydrates is one of the most important goals of post exercise recovery.			
65. Flavoured milk is a bad choice for a recovery drink, because it is high in sugar.			
66. The best time to replace glycogen is 3-4 hours after exercise.			
67. High and moderate GI, carbohydrate-rich foods are **good choices directly after exercise.**			
68. Combining carbohydrate and protein intake after exercise can slow down recovery and it is thus better to eat only carbohydrates after exercise			

69. After a 2-hour training session, it is better to choose water and/or coffee instead of a sport drink.			

Supplements and ergogenic aids:	True	False	Unsure
70. Supplements and shakes can make up for an athlete not eating a healthy diet.			
71. Iron supplements, calcium supplements and multivitamin/mineral supplements can be used to prevent or treat a nutrient deficiency.			
72. Supplementation with vitamins and minerals is necessary in athletes, even if a well-balanced diet is followed.			
73. Iron supplements should be taken under the supervision of a medical/ nutrition expert when a player feels extremely tired and is pale.			

Part III: Nutritional Advice Practices

74. Do you give nutrition advice to your netball players?

a. Yes	
b. No	

75. If you don't give advice, what is the reason for not giving advice?

a. No time	
b. Not confident with my level of nutrition knowledge	
c. Someone else provides athletes with nutrition advice	
d. Other (please specify):	

76. If you do give advice, which of the following topic do you give advice on? (more than one possible)

a. Fluid intake	

b. Supplements	
c. Pre-training/pre-competition foods	
d. Healthy eating/foods	
e. Weight control	
f. Foods to eat during training/during competition	
g. Recovering after training / competition	

77. Do you believe that good nutrition practices can improve sport performance?

a. Yes	
b. No	
c. Unsure	

78. How frequently would you read about nutrition related issues?

a. Never	
b. Weekly	
c. Monthly	
d. Six monthly	
e. Yearly	

79. What is your main source of information about nutrition?

a. Internet	
b. Popular magazines	
c. Sport magazines	
d. Health professional (please specify):	
e. Sponsors	
f. Other (please specify)	

80. Have you ever made use of a professional to give nutrition advice to your players?

a. Yes	
b. No	

If "Yes" please continue at Question 81. If "No" please continue at Question 82.

81. Which of the following professional have you used to give nutrition advice to players?

a. Sport nutritionist	
b. Dietitian	
c. Doctor	
d. Strength and conditioning trainer	
e. Physiotherapist	
f. Other (Please explain)	

82. Why have you not made use of a professional to give nutrition advice?

a. Own nutritional knowledge is sufficient	
b. Too expensive to make use of a professional	
c. Professional not available to give advice	
d. Other (Please explain)	

THANK YOU FOR YOUR TIME

ADDENDUM F

Author guidelines for The South African Journal for Research in Sport, Physical Education and Recreation (SAJR)

INFORMATION FOR AUTHORS

The *South African Journal for Research in Sport, Physical Education and Recreation* is published by Stellenbosch University. Contributions from the fields of Sport Science, Physical Education, Recreation/Leisure Studies, Exercise Science and Dance Studies will be considered for publication. The articles submitted will be administered by the appropriate Subject Review Editor and evaluated by two or more referees. The decision as to whether a particular article is to be published or not, rests with the Editorial Board.

SUBMISSION

Manuscripts that do not comply with the following requirements regarding process, style and format will not be handled.

Manuscripts should be typed with ***one and a half spacing*** in 12-point Times New Roman letter size for the text. All the text in tables and figures should be in 10-point Times New Roman font size. Please do not use *Calibri*. The original manuscript can be submitted by Email. The length may not exceed 20 pages (tables, figures, references, etc. included). The **page setup** (cm) must be in the following format:

MARGINS		**PAPER SIZE**	
Top:	3.56 cm	*Width*:	17.5 cm
Bottom:	1.78 cm	*Height*:	24.5 cm
Left:	2.11 cm		
Right:	2.11 cm		
Gutter:	0.00 cm		
Header:	2.03 cm		
Footer:	0.89 cm		

Original manuscripts may be submitted in English or Afrikaans and should be sent to:

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CONDITIONS

Each manuscript must be accompanied by a ***covering letter*** in which the following is declared: (1) that the manuscript contains original research; (2) that the manuscript or parts of the manuscript has not been published elsewhere previously; (3) that the manuscript is not currently being presented elsewhere for publication; and (4) that all the authors have read and approved the manuscript. This signed declaration regarding the originality must accompany each manuscript.

Authors are also requested to name three/3 potential referees, of which one/1 must be an *international* referee (the Journal is not bound to use these referees). Complete information regarding the referees (name, surname, e-mail address and telephone numbers) must be provided in the cover letter.

We discourage the practice of parts of one study in different journals. Authors who submit a manuscript from a study of which some data have been or will be published elsewhere, must provide a strong justification in the accompanying letter to the Editor. The justification for not publishing all the data together in one paper must also be motivated in the covering letter.

The author should also ensure that the ***language*** of the manuscript has been ***edited*** thoroughly (English [UK]) by the time of submission. The name, address and telephone number of the person who did the language editing must be provided. Any expenses incurred by the Journal dealing with language editing will be added to the author's page fees.

The manuscript must have an ***ethical clearance number*** that was supplied by the authentic ethical committee of a specific institution. The process that was followed to obtain ethical clearance must be described in the manuscript

under the heading, 'Ethical clearance'. No manuscript can be published without this declaration. Review articles do not need ethical clearance.

Any uncertainty regarding the ***statistical procedures*** that arise during the assessment of the manuscript will be referred to a local statistician. Any expenses incurred by the Journal dealing with statistical procedures will be added to the author's page fees.

PREPARATION OF MANUSCRIPT

Manuscripts must be presented in a format that is compatible with *Microsoft Word for Windows* (PC). Tables, all figures (illustrations, diagrams, etc.) and graphs are regarded as text and must be presented in a format that is compatible with ***Word*** and figures should be ***accessible*** to make any text corrections. Photographs must be presented in *jpg* format.

Original manuscripts must contain the following sections in the following sequence: Title page, Abstract, Introduction, Purpose of Research, Methodology, Results, Discussion, Practical application, Conclusions, Acknowledgements (if applicable) and References.

Title page

The first page of each manuscript should indicate the *title* in English and Afrikaans (will be translated for foreign authors), the *names* (title, first name in full and other initials, surname) of the author(s), the *telephone* numbers (work & home [& *mobile* for local authors]), *facsimile* number, *E-mail* address and the *field of study*. The ***complete mailing address*** and ***telephone numbers*** of the corresponding author and the institution (department, university, city, country) where the work was conducted should be provided in full. When more than one author and/or authors from various departments and institutions are involved, the **[1]*author*(s)** must be numbered according to their **[1]*department*(s)**. If any of the above-mentioned information should change during the review process, please inform the Subject Editor. A ***short title*** of not more than ***45 characters*** (including spaces), should be provided for use as a running heading.

Abstract

Each manuscript must be accompanied by an abstract of approximately 150-200 words in *English* and should be set on a *separate page* as a SINGLE paragraph (1.5 spacing). A list of three to seven ***key words*** in *English* is required for indexing purposes and they should be typed below the abstract. Articles in Afrikaans must include an ***additional*** extended ***summary*** (500-1000 words) in English. This summary must start on a new page (just before the reference list) and the English title of the article should be placed at the beginning.

Text

Start the text on a new page with the title of the article (centred and *without* the names of the authors). Follow the style of the most recent issue of the Journal regarding the use of headings and subheadings. Use only ***one line space*** after a paragraph. Only make use of ***section breaks*** and not ***page breaks***. The text, as well as the tables and figures, may not be in any other format than ***normal***. Thus, ***no style sheets*** may be used.

Tables and figures

Tables and figures should be numbered in *Arabic* numerals (1, 2, etc.). Tables require the heading at the *top*, while figures have the legend *below* and both are not included in the cells of the table/figure. ***Note:*** Use the decimal POINT (not the decimal comma). The site where the table or figure should be placed in the text must be indicated clearly in the manuscript. All tables and figures are to be placed *after the reference list* with each on a ***separate page***, always ending with a ***section break***. Any preference for the use of *colour* in the case of figures or photographs must be noted and will be at an *additional cost* to the page tariff.

It is essential that tables/figures should be contained/fit within the page setup described earlier for this Journal. Portrait layout must be maintained for all tables/figures. Tables must use separate rows/columns (do not merge cells) for each item. Figures must be in ***Word*** and accessible to make corrections or changes within the figure where deemed necessary. Please ensure that the figures especially are of high quality for printing purposes. Any preference for the use of *colour* in the case of figures or photographs must be noted and will be at an *additional cost* to the page tariff.

References

In the *text*, the Harvard method must be adopted by providing the author's surname and the date placed in parentheses. *For example:* Daly (1970); King and Loathes (1985); (Botha & Sonn, 2002); McGuines *et al.* (1986) or (Daly, 1970:80) where Daly is not part of the sentence and page number is added for a direct quotation. More

than one reference must be arranged ***chronologically*** (Daly, 1970; King & Loathes, 1985). Note that *et al.* (italics) is used in the body of the text from the beginning when there are ***more than two authors***, but never in the list of references, where all authors must be provided.

List of references

Only the references cited in the text should be listed alphabetically according to surname (last name) of authors (uppercase) after the body of text under the heading, **REFERENCES** (uppercase) starting on a new page. In the case where the TITLE of an article, book, etc., is in any other language than English, the author must also provide an ***English translation*** of the title in parentheses (this applies to Afrikaans titles as well).

In the case of articles published in ***JOURNALS***, references listed should include the surnames and initials (upper case) of ***all*** authors, the date of the publication in parentheses, the full title of the article, the full title of the journal (italics), the volume number, the series/issue number in parentheses (omitted only if the said journal does not use issue numbers), followed by a colon and a space with the first and last page numbers separated by a hyphen. The use of the correct punctuation is of importance.

If the reference is a ***BOOK***, the surname (last name, upper case) and initials (without spaces) of the author or editor (Ed.) must be provided, followed by the date of publication in parentheses, the title of the book (italics) as given on the title page, the number of the edition (ed.) in parentheses, the city (and abbreviation for the state in the case of the USA OR the country) where published, followed by a colon, a space and the name of the publisher.

For a ***CHAPTER*** in a book, the page numbers of the chapter cited must be provided in parentheses (not italics) after the title of the book. For further details, authors should consult the most recent publication of this Journal for other examples.

If the reference is a ***THESIS*** (master's level) or ***DISSERTATION*** (doctoral level), italics is **not** used in the title as it is an unpublished work. Provide the name of the city, state/country, colon, university and department/faculty.

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EXAMPLES OF STYLE OF FORMULATIONS FOR DIFFERENT REFERENCES

Journal

ZHENG, N.; BARRENTINE, S.W.; FLEISIG, G.S. & ANDREWS, J.R. (2008). Kinematic analysis of swing in pro and amateur golfer. *International Journal of Sports Medicine*, 29(6): 487-493.

Book

WEINBERG, R.S. & GOULD, D. (2011). *Foundations of sport and exercise psychology* (5th ed.). Champaign, IL: Human Kinetics.

Chapter in book

SCHNECK, C.M. (2010). Visual perception. In J. Case-Smith & J.C. O'Brian (Eds.), *Occupational therapy for children* (6th ed.) (pp. 373-403). Maryland Heights, MO: Mosby.

Thesis/Dissertation

SURUJLAL, J. (2004). Human resources management of professional sports coaches in South Africa. Unpublished doctoral dissertation. Johannesburg, South Africa: Rand Afrikaans University.

Proceedings of a conference

HARDMAN, K. & MARSHALL, J. (2001). Worldwide survey on the state and status of physical education in schools. In G. Doll-Tepper & D. Scoretz (Eds.), *World summit on physical education* (pp. 15-37). Proceedings of the "World Summit on Physical Education", 3-5 November 1999. Berlin, Germany: International Council of Sport Science and Physical Education (ICSSPE).

Personal communication/correspondence/interview

BOUKES, P.B. (2015). Personal communication from the Acting Director of Sport at the Nelson Mandela Metropolitan University, Port Elizabeth on 27 February 2015.

JACOB, L. (2015). Personal interview with the Spokesperson of UNICEF, 25 August, Pretoria.

Newspaper

CAPE ARGUS, *The* (1997). 25 March, p.5.

Electronic source

DINOFFER, J. (2011). "Activities to build balance". *Prevent child obesity 101.* Hyperlink: [http: //www.preventchildobesity101.com/Activities/BalanceActivities.php]. Retrieved on 20 November 2012.

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Criteria

Research should report data from original research and clinical trial outcomes. Authors are encouraged to refer to this checklist when writing their manuscripts.

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The information below details the section headings that you should include in your manuscript and what information should be within each section.

Please note that your manuscript must include a 'Declarations' section including all of the subheadings (please see below for more information).

Title page

The title page should:

- present a title that includes, if appropriate, the study design e.g.:
    - "A versus B in the treatment of C: a randomized controlled trial", "X is a risk factor for Y: a case control study", "What is the impact of factor X on subject Y: A systematic review"
    - or for non-clinical or non-research studies a description of what the article reports
- list the full names, institutional addresses and email addresses for all authors
    - if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the "Acknowledgements" section in accordance with the instructions below

- indicate the corresponding author

Abstract

The Abstract should not exceed 350 words. Please minimize the use of abbreviations and do not cite references in the abstract. Reports of randomized controlled trials should follow the CONSORT extension for abstracts. The abstract must include the following separate sections:

- **Background:** the context and purpose of the study
- **Methods:** how the study was performed and statistical tests used
- **Results:** the main findings
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Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should explain the background to the study, its aims, a summary of the existing literature and why this study was necessary or its contribution to the field.

Methods

The methods section should include:

- the aim, design and setting of the study
- the characteristics of participants or description of materials
- a clear description of all processes, interventions and comparisons. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses
- the type of statistical analysis used, including a power calculation if appropriate

Results

This should include the findings of the study including, if appropriate, results of statistical analysis which must be included either in the text or as tables and figures.

Discussion

This section should discuss the implications of the findings in context of existing research and highlight limitations of the study.

Conclusions

This should state clearly the main conclusions and provide an explanation of the importance and relevance of the study reported.

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All manuscripts must contain the following sections under the heading 'Declarations':

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- Consent for publication
- Availability of data and material
- Competing interests
- Funding
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- Authors' information (optional)

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Hao Z, AghaKouchak A, Nakhjiri N, Farahmand A. Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare. 2014. http://dx.doi.org/10.6084/m9.figshare.853801

With the corresponding text in the Availability of data and materials statement:

The datasets generated during and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].[Reference number]

Competing interests

All financial and non-financial competing interests must be declared in this section.

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Please use the authors initials to refer to each authors' competing interests in this section.

If you do not have any competing interests, please state "The authors declare that they have no competing interests" in this section.

Funding

All sources of funding for the research reported should be declared. The role of the funding body in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript should be declared.

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The individual contributions of authors to the manuscript should be specified in this section. Guidance and criteria for authorship can be found in our editorial policies.

Please use initials to refer to each author's contribution in this section, for example: "FC analyzed and interpreted the patient data regarding the hematological disease and the transplant. RH performed the histological examination of the kidney, and was a major contributor in writing the manuscript. All authors read and approved the final manuscript."

Acknowledgements

Please acknowledge anyone who contributed towards the article who does not meet the criteria for authorship including anyone who provided professional writing services or materials.

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Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

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Example reference style:

Article within a journal

Smith JJ. The world of science. Am J Sci. 1999;36:234-5.

Article within a journal (no page numbers)

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine. 2013;11:63.

Article within a journal by DOI

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. Dig J Mol Med. 2000; doi:10.1007/s801090000086.

Article within a journal supplement

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. Blood 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. International review of cytology. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. Top Curr Chem. 2007. doi:10.1007/128_2006_108.

Complete book, authored

Blenkinsopp A, Paxton P. Symptoms in the pharmacy: a guide to the management of common illness. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: The dictionary of substances and their effects. Royal Society of Chemistry. 1999. http://www.rsc.org/dose/title of subordinate document. Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. http://www.healthwise.org. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. http://www.privatehomepage.com. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. http://www.uni-heidelberg.de/mydata.html (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. ftp://ftp.isi.edu/in-notes/rfc2169.txt (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. http://www.issn.org (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (Sorghum bicolor). GigaScience Database. 2011. http://dx.doi.org/10.5524/100012.

Figures, tables and additional files

See General formatting guidelines for information on how to format figures, tables and additional files.