Diet and Supplementation Practice in Professional Ethiopian Football Players: Effects on Performance and Recovery

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DECLARATION

I, Mr Tesfaye Berhane Masho, hereby declare that this dissertation is all my own work and that appropriate credit has been given where reference has been made to the work of others and it has not been submitted in any form to the University of KwaZulu-Natal or any other Institution.

Signed _____ Date_____

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LIST OF ABBREVIATIONS

1.	ADAFC.	Adama Football Club
2.	ARMKFC.	Arbaminch Kenema Football Club
3.	BMI	Body Mass Index
4.	CBEFC.	Commercial Bank of Ethiopia Football Club
5.	CHO	Carbohydrate
6.	Cm	Centimetre
7.	DASHBFC	Dashen Beer Football Club
8.	DDFC.	Dedebit Football Club
9.	HADYAFC	Hadya Kenema Football Club
10.	Kg.	Kilogram
11.	M	Mean
12.	PAL	Physical Activity Level
13.	SD	Standard Deviation
14.	SGFC.	Saint George Football Club
15.	YYIRT1	Yoyo Intermittent Recovery Test Level 1

ABSTRACT

The game of football places high physiological demands on players, who are expected to react by carrying out a range of physical activities at different intensities. Such movement patterns contribute to a high energy turnover in both training and match-play, which in turn must be sustained by the intake of adequate fuel sources. In this thesis, three studies were undertaken with the intention of gaining greater insight into, and adding to the body of knowledge of, football nutrition in Ethiopia. The studies included an evaluation of the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period 2012 to 2014 (Study 1). The dietary intake, sports nutrition and supplementation practices of professional Ethiopian football players currently playing in Ethiopian Premier League clubs (Study 2) were then studied, as well as the relationships between training load, energy balance, performance and recovery (Study 3).

Study – 1. Football players require adequate knowledge of nutrition to allow correct selection and consumption of food and fluids to meet their performance, body composition and overall health needs. The aim of this study was to examine the effect of a sports nutrition intervention on the nutrition knowledge and dietary choices of the players who were members of the Ethiopian national football squad between 2012 and 2014. The following sports nutrition topics were discussed: timing of nutrition, recovery, hydration, post exercise physiological perceptions, macronutrients, sports drinks, fruit and vegetables, alcohol and its impact on performance. Participants attended nutrition education sessions for six months, each one 20 to 30 minutes in duration. Interview and focus group discussions were administered to 20 Ethiopian national squad players and the head and two assistant coaches working with them. The data were analysed using manual coding matrices. The analysis of the interview data revealed that all the national team players exhibited significant knowledge of football nutrition after the nutrition education intervention. The intervention helped them to adhere to proper dietary and recovery procedures, and also significantly helped the players understand dietary CHOs as a vital source of fuel for football which as a result benefited them to change their misconception they had about CHO before the intervention. Some players had believed, at the beginning

of the intervention, that alcohol had an ergogenic effect. In conclusion, this study revealed that nutrition education for professional football players can have positive results. The education programme must be entertaining and should not be too long. Based on these findings, was concluded that football players in Ethiopia would benefit from nutrition education targeting an improvement in nutrition knowledge and dietary practices.

Key words: Ethiopian national squad football players, dietary practices, Nutrition education, nutrition knowledge.

Study – 2.

Similarly, to other professional football players, Ethiopian players require appropriate nutritional intake because of the physiological demands of the game. To understand the dietary practices and nutrition plans of these players, a dietary assessment of current Ethiopian professional players was conducted.

The aim of this study was to assess the dietary intake of 126 players age *M* = 27.3, ±SD = 3.0 years), weight *M* = 72.4, ±SD = 7.0 kg, height *M* = 1.77, ±SD = .06 m, BMI *M* = 23.1, ±SD = 1.6 kg.m^2 from seven Ethiopian premier league football clubs; during a competitive week, over a four-day period. Food was weighed and means (standard deviation) and 95% confidence limits were calculated and compared across clubs using one-way analysis of variance followed by Bonferroni post-hoc testing.

There were significant differences in dietary macronutrient composition across the teams in the four study periods, the dietary intake in g/day and in g/kg of body weight for CHO on Thursday was significantly different *M* = 344.6, ± SD = 12.5, p = 0.030, g/day compared with Monday's dietary CHO intake, in g/day and in g/kg of body weight, *M* = 308.3, ± SD = 96.4 g/day. The study revealed a dietary CHO intake was below the recommendation of 500-600 g/day. With great significant difference among clubs ranging from M = 459.9, ± SD = 104.1, p < 0.001. g/day to *M* = 256.0, ± SD = 58.5, p < 0.001

The mean dietary CHO, compositions in g/kg of body weight, across the teams were significantly different ranging from, 3.6 (.9) g/kg of body weight to 6.1 (1.3) g/kg of body weight.; In conclusion, the results show that the nutritional intake of the players was not optimal unlike protein and fat the mean daily CHO intake of Ethiopian professional football players was lower than recommended. These findings may have both short- and long-term negative consequences on the performance and recovery as well as health of the players. On the basis of our results, we recommended that nutritional education should be given to the players at an early age and should continue throughout adolescence.

Key words: Ethiopian premier league, Dietary macronutrient intake, dietary assessment.

Study – 3. It is important that football training load, which includes functional testing, is closely linked with optimal energy intake. This enhances performance and recovery process between training sessions. The aim of this study was to investigate the associations between dietary practice and performance and recovery of twenty professional Ethiopian football players from the same team (M = 23.8, ± SD = 3.3 years). During an intense seven-day, (Monday to Sunday) pre-season training period, food was weighed and recorded, and total and macronutrient energy intake was determined, and energy expenditure calculated. Performance testing (Yo-Yo Intermittent Recovery Test Level 1 (YYIR1) was also performed pre- and post the seven-day period. Data were expressed as the mean (standard deviation). A one-way ANOVA, with Bonferroni post-hock testing, paired t-tests, Pearson correlation, and multiple regression were used in the statistical analysis. The mean dietary intake for protein was significantly higher in terms of daily intake in grams and per kilogram of body weight across the seven days ranging from M = 257, ± SD = 44, $p < 0.001$ g/day, to M = 168, ± SD = 24, $p < 0.001$, g/day. And M = 3.6, ± SD = .7, $p < 0.001$ g/kg of body weight to M = 2.3, ± SD = .4, $p < 0.001$ g/kg of body weight. Overall, our results show that the nutritional intake of the players was not optimal and resulted in a high mean daily energy deficit of M = -144.8, ± SD = 1111.7 calories was observed between the energy intake of M = 3765.1, ± SD = 1104.7 calories and the energy expenditure of M = 3909.9, ± SD = 191.2 calories. The study revealed that

dietary fat was the highest source of energy, which is not the preferred fuel for football players. The mean distance covered post the seven days of training for the YYIR1 significantly decreased by 25% (pre: *M* = 2266 ± SD = 526 m versus post: *M* = 1666 ± SD = 456 m). This result represented a 10% decrease in VO_2max values among the study participants from session 1 pre: *M* = 55.4 ± SD = 4.4 ml/kg/min versus post: *M* = 50.4 ± SD = 3.8 ml/kg/min. In summary, the YYIRT1 result may have been related to the energy deficit of the players over the seven days of pre-season training. In addition, players consumed higher levels of dietary fat and low levels of CHO during intense training, which is not the recommended for optimal performance and recovery in professional football players

***Key words**:* Preseason training, YYIRT1, energy balance and training load.

In conclusion, the studies included in this thesis found that 1) elite Ethiopian football players benefitted from a sports nutrition education intervention, 2) there is a disparity in macronutrient composition across football teams participating in the Ethiopian Premier League and 3) energy deficit during a week of intense preseason training is associated with reduced performance and recovery of players.

CHAPTER 1. INTRODUCTION

Strenuous training and match-play place a heavy stress on the body, but good food choices can reduce the risk of injury (Maughan, 2006). Nutrition is a vital part of sport performance and recovery for young as well as senior athletes (Purcell, 2013). In addition to its role in growth and development, it also has a vital impact on the overall health of athletes (Murphy & Jeanes, 2006). It is well acknowledged that optimal nutrition for athletes includes the intake of adequate and appropriate amounts of macronutrients, micronutrients and fluids during training and competition (Cockburn, Fortune, Briggs, & Rumbold, 2014; Purcell, 2013). Despite this knowledge, there are misconceptions amongst footballers about optimal nutrition (Andrews, 2016). They therefore need assistance from different sources, for example the coach and team sports nutritionist, to learn what, when and how to eat and drink before, during and after exercise. In addition to guidance from professionals, football players should also be educated about optimal nutritional practices. Nutrition education can therefore play an important role in guiding footballers about optimal sports nutrition (Cockburn et al., 2014; Valliant, 2012).

In the 21st century, football performance depends on proper nutrition, recovery and training (Canada., 2000). However, a lack of understanding about sports nutrition is demonstrated by football coaches, even in countries with successful football teams (Mutsumi Onoa, 2012). Anecdotally, and relevant to the proposed study, individuals in sports managerial positions in the Ethiopian Football Federation and clubs also lack knowledge about the importance of sports nutrition (Ingram & Davies, 1996; Onoa, 2012).

Based on the researcher experience working as a sports nutritionist with Ethiopian professional football players for two years, it was realised that Ethiopian players do not currently follow a recommended sports nutrition regimen for optimal performance in football. Because of this, their performance and recovery is compromised (Pramukova, Szabadosova, & Soltesova, 2011). To the best of the PI's knowledge, there is no research on football nutrition in Ethiopia. The current practices are guided by tradition, which only focuses on what the players 'eat at home', instead of what is important to them for football

training and competing. This is an important factor in explaining the poor achievement of Ethiopian football over the last 31 years. Therefore, based on this experience, the researcher felt that this area should be the focus of this Ph.D. study. Rather than focusing only on sports nutrition practices, it was felt that daily dietary intake as well as supplementation practices should be studied, both at international (PhD study 1) and professional club (PhD study 2) level (Melinda , Valliant, Pittman Emplaincourt, Wenzel, & Garner, 2012). In addition, it was felt that an evaluation of physical performance and recovery should include looking at players' energy balance and training load. This vital study focused on professional Ethiopian football players (PhD study 3).

1.1. Background

The ancient Greeks were aware of the relationship between diet and exercise. The modern history of sports nutrition dates back at least 100 years to the Olympic Games, where protein was thought to be the main source of fuel for the athletes. This initial practice laid the foundation for the evolution of sports nutrition (Jeukendrup, 2004; Torres-McGehee, 2012).

The Sports Nutrition Position Standards of the American Dietetic Association, Dieticians of Canada, and the American College of Sports Medicine have concluded that physical exercise, athletic performance, and recovery from exercise are improved by optimal nutrition (Canada., 2000). Therefore, it is vital that nutritional assessments are performed on Ethiopian professional football players at the club level, as these are the athletes recruited into the national team. Previous football studies have reported that players, like all people, have special nutritional needs, and that the diets of many players are found to be inadequate (Molina-López et al., 2013a).

1.2. Statement of the problem

As the former Ethiopian football team nutritionist, the researcher was well placed to understand the problem faced by Ethiopian Footballers. Specifically, coaches, managers

and conditioning specialists in the Ethiopian Football Federation (including national and club level) focus on the technical, tactical and conditioning aspects of the game and the dietary and supplementation practices of players have been overlooked. This is seen to negatively impact on the physical performances and recovery of the players. Consequently, the technical and tactical aspects are also negatively impacted during games (Harper, West, Stevenson, & Russell, 2014).

1.3. Research questions

1) How did a sports nutrition education programme, implemented by the researcher, impact on the dietary, sports nutrition and supplementation practices of the Ethiopian national football squad during the World Cup qualifying period from 2012 – 2014?
2) What are the current dietary intake levels and practices (including sports nutrition and supplementation) of professional football players playing in Ethiopian Premier League clubs?
3) What is the impact of the dietary practices on the performance and recovery of professional Ethiopian football players?

1.4. Aims

The overall aims of this PhD were to record and evaluate dietary, sports nutrition and supplementation practices of Ethiopian professional football players (at national and club level) and to examine the impact of pre-season dietary practices on performance and recovery of the players.

Specifically, the PhD is divided into three studies with the following aims:

1) To evaluate the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period of 2012 to 2014. (Study 1).

2) To measure the dietary intake and record the sports nutrition and supplementation practices of professional Ethiopian football players currently playing at Ethiopian Premier League clubs (Study 2).
3) To measure the effects of pre-season dietary practices on the performance and recovery of Ethiopian professional football players (Study 3).

1.5. Significance of the study

The significance of this study lies in the reality that proper dietary and supplementation practice of professional football players in Ethiopia are overlooked. To date, the nature and extent of the problem in Ethiopian footballers has not been researched or reported in the literature. Therefore, the study is original and has potential to have a significant impact on sports nutrition, dietary and supplementation practices in Ethiopian football.

1.6. Thesis Outline

The thesis consists of 5 chapters with Chapter 1 providing an introduction to the study including the problem statement, the demarcation of the field of study, as well as the study significance.

Chapter 2: Review of literature. This chapter provides a summary and evaluation of the literature surrounding nutritional practices in football, as well as examines the dietary recommendations for optimal performance and recovery in football.

Chapter 3: Methodology Chapter 3: This chapter examines the research methods employed to conduct this study. It discusses the nature of the study, the survey method and the research instruments employed.

Chapter 4: Results and discussion. This chapter provides the findings of the three studies and discusses and evaluates the findings in relation to the available literature.

Chapter 5: Conclusions and recommendations. This chapter draws conclusions based on the findings and thereafter proposes recommendations for how the findings should be applied.

CHAPTER 2: LITERATURE REVIEW

Introduction

Football is the most popular sport worldwide. Like all sports, diet has significant impact on training. The first section of this chapter will focus on physiological demands of the players and the impact of proper dietary practice, the second section will focus on macronutrient requirements, the impact of proper hydration, micronutrient requirements, and the last section will focus on factors that affect optimal nutrition in football as well as the impact of nutrition education.

2.1. The physiological demands and total distance covered in football

Football is a team sport characterized by recurrent bouts of short duration, high-intensity dashes which, together with skills, that have to be sustained for an entire match. Games last for 90 minutes, plus overtime (as needed). They are divided into two 45-minute halves with a 15-minute pause between halves. The distance run by a football player during a normal game ranges from ~8 to 13 km.

This distance is covered in an unpredictable, intermittent exercise pattern. The variations observed in the activity patterns of players are unique in nature and include changes in intensity, direction and mode of movement. Superimposed on this activity profile are movements that are directly related to play in the match. These include technical actions such as kicking, throwing, dribbling and heading the ball; and physical challenges with opponents to contest possession (Di Salvo, Gregson, Atkinson, Tordoff, & Drust, 2009). All this work imposes a physical burden on the players and contributes to making football a highly physiologically demanding sport.

Computerized time-motion and semiautomatic video-based system analyses have shown that professional football players log 2 to 3 km of high-intensity running (>15 km/h) and ~0.6 km of sprinting (>20 km/h) (Iaia, 2009). These running and sprinting distances are,

respectively, 28% and 58% longer than those of moderate-level professional players (Mohr, Krustrup, & Bangsbo, 2003). Less effective teams log shorter total sprint distances during games, suggesting that the ability to maintain high-intensity activity throughout a game is very important.

Increased demands of the professional sport have influenced contemporary thought, with researchers and professionals generally stressing the significance of physical performance and its connection to match results. The physical aspects of the game are increasingly seen as the deciding factor in match results (Carling, 2013). The management of the physical and physiological well-being of top football players depends on critical knowledge about the demands of performance (Jonathan Bloomfield, 2007). Football is increasingly becoming an intense, physically demanding game and the ability of players to cover large distances is crucial. If they are to do this, their bodies require the right fuel to meet the demands of a match (Jenkins, 2014).

2.2. Distance covered and energy expenditure for player positions

The distance covered during a match is influenced by the fitness levels of players, playing positions, level of play, tactics employed and weather conditions. The estimated average energy expenditure of football players during a regular match is 16 kcal/min, corresponding to an oxygen consumption (VO_2) of ~75% of maximum (Baker, 2014).

Football is known to be physically demanding, and these demands are specific to each position of play. Midfield players log the most high-intensity dashes in their role linking the defence and forwards. Central defence and forwards cover the shortest overall distance (Jenkins, 2014). It has been estimated that between 80 and 90% of a match is spent in low to moderately intense activity; while the remaining 10 to 20% is high intensity activity. This results in frequent bouts of aerobic and anaerobic movement which

place huge stress on players' bodies. Consequently, their blood lactate concentration can rise, which will affect their performance negatively (Bloomfield, 2007).

To meet the physiological demands of a football player, one must consider player position and provide the right nutrition for specific demands for athletes playing team sport, Sports Dieticians and Nutritionists often have to overcome unique challenges as many cultural, economic and psychological factors may interfere with the business of football. Dieticians and/or nutritionists must complement their nutrition-specific duties with social interaction in the daily routines of football players and staff (Holway & Spriet, 2011). They are expected to understand the unique energy expenditure of each player according to their player position and so determine the correct daily requirements for each player.

For a first-class footballer, nourishment is vital to supply energy to meet the challenges of high-powered, intermittent exercise. Top level athletes, in particular, have to meet the demands of high-intensity exercise. This, in combination with the large number of matches in a season, increases the importance of recuperation nutrition. The prescribed diet needs to include a few key elements to help both the well-being and performance of a player. The primary consideration ought to be that players eat the correct nutrition to meet their daily demands for energy while training and playing matches. Daily energy expenditure for a first-class footballer will depend on the time of the football season, whether there are one or two training sessions in a day, and the number of matches played in seven days. There are substantial variations in energy expenditure depending upon the mode of preparation (for example, a hard day of field-based instruction and resistance training; or an indoor recuperation session). Players must adjust their general energy (calorie) intake to maintain their energy levels, while also achieving key macronutrient targets (Collins, 2014).

2.3. Fatigue in football players

Studies measuring high-power running and distances covered have shown that distances covered are shorter in the second half, compared with the first half, of a match. This suggests that performance is restrained in the second half and exhaustion develops towards the end of a match Fatigue is mainly observed in centre-backs and attackers, and is less likely in midfield players and full backs who are likely to have the greater maximal aerobic capacity (Mohr, 2005; Reilly, 1997), mostly because of physiological and psychological reasons.

Exhaustion seems to occur briefly during the game. However, it is unlikely to be caused by raised muscle lactate, decreased muscle pH, or changes in muscle energy. It is unclear what causes this short-lived, diminished capacity of players to perform maximally (Bangsbo, 2007). However, muscle glycogen decreases by 40% to 90% during a game, and as the most important factor for energy generation, tiredness toward the end of a game may be linked to the amount of glycogen in some muscle fibres. Blood glucose and catecholamines increase, and insulin levels decrease, during a game (Bangsbo, 2007). Therefore, a decrease of this magnitude may cause fatigue during the game, especially at the end of 90 minutes.

2.4. Causes of fatigue in football players

In first class football, players are often required to play successive matches three days apart and full physical recovery may not be achieved. Inadequate recovery may lead to under-performance and injury. Within busy timetables, recuperation systems are necessary to minimise post-match fatigue, ensure faster performance recovery and lessen the danger of injury. Football includes physically demanding movements, including sudden dashes, changes in running speed, changes of direction, hops and tackles; as well as football-specific activities, such as dribbling, shooting and passing. These exercises can be linked to post-match fatigue that is caused by a combination of dehydration,

glycogen consumption, muscle injury and mental fatigue. The intensity of the soccer match is also related to fatigue. Extraneous elements (match outcome, competitiveness of the rival, match area, playing surface) or potentially inherent elements (training status, age, sexual orientation, muscle fibre typology) possibly impact the length of time needed for recovery. Recuperation in soccer is a perplexing issue, strengthening the requirement for future research to assess the quantitative significance of fatigue mechanisms and recognize causative components. Productive and individualized recovery techniques may consequently be proposed (Nedelec et al., 2012). Without this, the current high intensity nature of football may cause under-performance. Here, post-match nutrition becomes paramount (Jenkins, 2014). Dehydration has been identified as a factor responsible for the development of fatigue in the last stages of a football game and rehydration needs to be carried out immediately. This is a credible finding, as even moderate dehydration is known to be linked with poor endurance-based exercise responses, both in a controlled laboratory environment and also in more football-specific field conditions (Noakes, 2009) where it results in reduced total distances covered and poor performances.

2.5. Dietary habits of football players

Despite football being popular, and football-centred scientific research is a growing field, minimal attention has been given to the nutritional intake and eating habits of football players. Some studies that have addressed this topic have concluded that the nutritional intake of football players is insufficient, highlighting the need for better discipline in following nutritional recommendations and the development and implementation of nutrition education programmes (García-Rovés, 2014). Optimal nutritional intake that has the correct nutrients and sufficient calories is vital to supply the necessary fuel sources; namely CHO, protein and fat. Appropriate nutrition can improve energy supplies for competition, lessen fatigue and allow players to work for longer and recover faster between sessions, as well as maintain general well-being (Murphy & Jeanes, 2006). Even though nutrition plays an essential role in players' performance, it is unclear to what extent knowledge about nutrition is associated with physical fitness of the player (Nikolaidis & Theodoropoulou, 2014).

Soccer is a sport demanding both aerobic and anaerobic energy transfer systems. An estimate of the energy cost of training or match-play in elite players is above 1500 kcal. The transfer of energy during the game relies on muscle glycogen and free-fatty acids. Thus, football players should follow a diet giving enough CHO and supplying all nutrient requirements. The consumption of CHO might go from five to seven grams per kilogram during moderate training to ten grams per kilogram during heavy training or match-play. The diet should include 55 - 65% CHO, 12 - 15% protein, and less than 30% fat (Nikolaidis & Theodoropoulou, 2014). Although this is a requirement for top football players, most of them do not meet the requirement especially CHO requirement (Anderson, 2017). This may simply be because of their eating habits, or due to a lack of knowledge about nutrition. Athletes need to follow diets which supply recommended levels of nutrition. One of the most important strategies to help athletes consume an adequate diet is nutrition education (Molina-Lopez et al., 2013).

2.4.1. CHO intake of football players

The availability of CHO as a fuel for muscles and the central nervous system is a crucial factor in performance during continuous sessions (>90minutes) of submaximal or intermittent, high-intensity or power, exercise; and it plays an important part in the execution of brief, high-power work. Overall, body CHO stores are limited, and they are regularly considerably lower than the fuel requirements during the daily practice sessions of many players (Burke, 2001). However, CHO consumption before and during work-outs, and in the recuperation time between delayed exercise sessions, gives a variety of alternatives to expanding body CHO availability in the short term. CHO intake systems that keep up, or improve, CHO levels appear to lessen or defer the onset of exhaustion or fatigue, and improve execution during a single session of delayed exercise (Karelis, 2010).

Every training program is based on three cardinal principles, namely intensity, frequency and duration (Williams, 2014). It is vital to consume the correct amount of CHOs to

support the demands of the game. CHO have been shown to be the most metabolised fuel during a football match (Alghannam, 2013). Research has shown that athletes undertaking high volume intense training (three to six hours in one or two workouts for five or six days per week) may need to consume 8 - 10g/kg/day of CHO (Pramukova et al., 2011).

FIFA Recommendation of CHO intake for football players

Immediate recovery up to 4 hours	1grs/BW/hour
Moderate to low intensity	5-7 grs/kg/day
Moderate to heavy	7-10 grs/kg/day

FIFA (the world controlling body for football) currently recommends the following targets as presented in the table above for CHO intake for football players: for immediate recovery after exercise (up to four hours), about one gram per kilogram of the player's body weight per hour, consumed at frequent intervals; for daily recovery from a moderate duration/low intensity training session, five to seven grams per kilogram of body weight per day; for recovery from moderate-heavy endurance training (such as pre-season), and fuelling up for a match, seven to ten grams per kilogram body weight per day (Maughan, 2006).

Based on this recommendation, it is important that players should consume CHO based on their body composition and activity profile in addition to their positional role. The body handles various types of CHO differently (Karelis, 2010). CHO that are digested and absorbed slowly can help to control insulin response and are appropriate for low to moderate levels of exercises. These should be eaten before training and competition for steady fuel provision to the working muscles. This CHO are higher in fibre and lower in simple sugars, such as beans and legumes. In contrast, a diet consisting of added sugars and refined CHO or simple sugars (which enter the body rapidly), can elevate blood glucose levels and lead to insulin resistance if there is long term consumption. It is advisable to eat these after training or competition. Finally, the timing of consumption, and types of CHO, are also key for the performance and recovery of the players (Jensen, 2012)

2.4.2. Protein intake of football players

Very few investigations have explicitly evaluated the protein requirements of football players. However, a hand-full of studies have assessed this requirement by determining the nitrogen balance of adolescent male football players. It has been established that the protein requirements of these players were above the recommended daily allowance of non-exercising adolescents, and a positive nitrogen balance from a mean protein intake of 1.57 g/kg BM was reported (García-Rovés, 2014). Proteins are nitrogen-containing substances that are formed by amino acids. They serve as the major structural component of muscle and other tissues in the body (Hoffman & Falvo, 2004). Muscle damage caused by the stress of exercise in football has been managed with optimal amounts of protein intake (Hoffman & Falvo, 2004). The protein requirements for athletic populations have been the subject of much scientific debate. Only recently has the idea become generally accepted that athletes striving for both strength/power and endurance require a greater protein intake than the general population (Hoffman & Falvo, 2004).

However, based on the PI's experience with the Ethiopian national team, the players were initially consuming excessive amounts of meat protein because of cultural influences. In Ethiopian society, meat is typically eaten by individuals with a higher socioeconomic status (higher class). Meat is unaffordable for most Ethiopians (Lokuruka, 2006; Belay, 2005, Seleshe, 2014). This was to the detriment of CHO and fat intake. Some scientists have suggested that endurance and resistance-training exercise increases daily protein needs up to a maximum of 1.2-1.6 g/kg per kilogram of body weight (BW). This is 50 - 100% more than the recommended intake of 0.8 g/kg of BW for a sedentary person (Maughan, 2006). According to Pramukova et al., competitive athletes require 1.5 - 2 g/kg of protein daily (Pramukova et al., 2011). This has been shown to maintain nitrogen balance and prevent protein catabolism that slows post-exercise recovery (Pramukova et al., 2011). Some research has noted greater protein intake of up to 2.0 g/kg/day (Hoffman & Falvo, 2004). Research also suggests that the timing and quality of protein intake is important for performance and recovery in football players (Potgieter, 2013). Similar research also noted that the protein intake of male football players ranges from 1.5 to 1.8

g/kg of body weight (García-Rovés et al., 2014). So, unlike with CHO intake, a nutritional assessment of football players generally discloses that protein intake is even higher than the desired amount which tends to vary from 1.6 g/kg of BM to 1.8 g/kg of BM. As a result, importance should not only be placed on the amounts of proteins eaten, as the recommended intake is easily and sometimes even unintentionally achieved by most football players from a variety of food sources with various amino acid profiles, but also on the timing and quality of protein intake (Jenkins, 2014).

2.4.3. Fat intake of football players

Fat is a necessary component of a normal diet, providing energy and essential elements of cell membranes and associated nutrients such as vitamins A, D, and E. Metabolically, the presence of essential fat in the gastrointestinal tract will help to absorb fat soluble vitamins (Beals, 2013). Therefore, fat intake is crucial for footballers. Lipid requirements of athletes are similar, and are slightly higher than those in non-athletes (Beals, 2013; Potgieter , 2013). The ACSM recommends that the daily lipid intake for athletes should be 20 - 35% of the total daily energy intake and that lipid intake should not decrease below 20% of the total daily energy intake (Potgieter , 2013) Research has found that it is difficult to estimate the contribution of lipid metabolism in intermittent sports such as soccer. However, the limited information available indicates that, given the highly aerobic nature of soccer, lipid oxidation is likely very important, especially during periods of rest after high intensity activities during match-play or training (García-Rovés et al., 2014). However, athletes restrict dietary fat intake as they are afraid that it may increase body weight and negatively impact their health (Beals, 2013). Recently, the importance of fat for the enhancement of health and performance has been reported in the literature (Macaluso et al., 2013). But studies conducted on male football players have testified that fat consumptions >30%, and consumptions of 37% or more, are not unique; and as a consequence this great lipid intake noticeably limits the chance of attaining an adequate intake of CHO (García-Rovés et al., 2014).

2.5. CHO and performance of football players

Since the 1960s and early 1970s, the role of CHO in athletic performance had been proven. However, even though soccer is the most popular sport in the world, few studies on soccer nutrition have been forthcoming. In one earlier investigation, an examination of glycogen depletion showed that the muscles of players were nearly emptied of glycogen after a match (Kirkendall, 2004). This suggests players are possibly running less in the second half of the game. This highlights the significance of intramuscular glycogen levels for practice and performance. The portion of fuel derived from glycogen stores depends to a large degree on relative exercise intensity, in addition to factors such as diet, training status and environmental conditions (Jacobs, 1982). Performance at the end of a football match is compromised, which may be caused by lower levels of muscle glycogen and a diminution of glycogen in specific muscle fibres (Rollo, 2014). To cope with this, it has been found that increasing muscle glycogen before sustained intermittent exercise, using a high-CHO diet, boosts performance (Gunnarsson et al., 2013). This insight is also supported by studies that recommend that players must consume an easily digestible, high-CHO meal in the hours before an endurance workout to increase muscle and liver glycogen stores and increase performance (Williams, 2008). Many studies have therefore confirmed that CHO are the footballer's fuel and players need to consume them appropriately to enhance their performance (Rollo, 2014).

2.6. CHO requirements for football players

Availability of CHOs as nourishment for the muscles and central nervous system is vital for good performances in both intermittent, high-intensity exercise and sustained, aerobic workouts. Any practices that support CHO availability, such as consuming CHO earlier, throughout practice, and afterwards, are critical for the performance of many athletes in sports like football, and are a crucial element of current sports nutrition procedures (Burke, 2010). Procedures for day-to-day CHO consumption have advanced from the 'one size fits all' recommendation for high-CHO diets, to a customised method of assessing energy requirements based on each player's body size and workout programme

(Burke, 2010). CHO normally constitute the highest proportion of all three fuel-giving nutrients of a diet. There is growing confirmation that the type of CHO being consumed is an important factor which impacts exercise performance.

The CHO recommendations for football players have been widely recognised as between 60 to 70% of the day-to-day consumption, due to the physiological demands of the game (Burke, Hawley, Wong, & Jeukendrup, 2011). More inclusive recommendations suggest that football players involved in modest to energetic practice need to aim to eat a high CHO food from nutrient-rich, unprocessed CHO food sources in an amount of 7 g/kg of body weight to 10 g/kg of body weight; more if they are involved in heavy training or need to recover energy (Jenkins, 2014). Even though it is well known that consumption of CHO before exercising or playing matches is crucial to improve performance, players are also expected to know the type of CHOs to consume. The particular CHO selected also depends on the time of consumption; and most of the CHO should come from nutrient-dense unprocessed foods, also known as complex CHO, rather than simple CHO, typical of foods containing refined sugars. This is especially important for prolonged activity. (Little, 2010).

CHOs are normally classified based on their glycaemic index (GI), which is a ranking of how fast CHO increases blood glucose levels in the body following consumption. High GI CHOs are immediately digested and absorbed by the body, a process resulting in a rapid increase in blood glucose, triggering a rise in insulin supply, with glucose as substrate; thus, sharply increasing liver and muscle glycogen (Little, 2010). Foods in this category have a GI index of 70 or above, and include bagels, white bread, most breakfast cereals, white rice, sports drinks, soft drinks, sugar, honey and candies. Low-GI foods, on the other hand, are CHO that are digested and absorbed gradually, leading to a lower increase in circulating glucose and insulin. Foods in this category are those with a GI index of less than 55, such as beans, milk, brown pasta and nuts. Players should also be aware that their energy demands will change weekly, through the season, and throughout their professional careers. They are expected to regulate their CHO consumption reasonably (Burke et al., 2006). However, all clubs in Ethiopia make their players eat

together all year round in the same facility, where the list of options is similar for all players. This is not flexible enough to provide for the range of energy and CHO needs of various players (Burke et al., 2006).

2.7. Protein and performance of football players

Many beliefs and misunderstandings occur with respect to football performance. For instance, in the past meat was connected with muscle and strength, and even now many footballers believe they need plenty of protein-rich food to perform optimally (Meredith, Zackin, Frontera, & Evans, 1989). This is one good reason why players need nutrition education: to dispel misconceptions about the role of protein in helping football players' performance, which depends on how much aerobic-based versus resistance-based activity, the players perform (Murphy, 2006). Players seeking to increase muscle mass and strength probably need to consume higher amounts of protein compared with endurance-trained counterparts; hence the significance of protein intake for endurance performance is limited. The key motivation behind the large quantities of dietary protein consumed by football players is that it is needed to make more muscle protein, especially during pre-season preparation periods (Phillips, 2011). It should be noted that the main fuels used to generate energy in soccer players are CHO and fats; and to some extent the oxidation of amino acids may contribute less than 5% of total adenosine triphosphate supply.

2.8. Protein requirements for football players

The increased protein needed for a football player may be related to the catabolic effects of their workouts, or to persistently high rates of amino acid break down. This would suggest that players training at intensities of about 70% of VO_2max for many hours per week undergo constant periods of net protein metabolism. With an increase in the irreversible oxidation of leucine and perhaps other indispensable amino acids, as well as loss of nitrogen, they have an increased need for dietary protein compared to sedentary

persons (Meredith et al., 1989). Thus, the reason why professional players need more protein is due to the stress of exercise that causes muscle damage. Studies have shown that drinking a CHO electrolyte drink promotes performance during prolonged training by supplying energy for active muscles and encouraging on-going fluid balance. It has been shown that putting a slight amount of protein into a normal sports drink will increase endurance ability in athletes by about 30%, compared with the sports drink alone (Gibala, 2007). According to studies, immediate post-exercise protein intake with the proportion of (80 g CHO, 28 g Pro, 6 g fat), may benefit the player in many ways, including the restoration and creation of muscle proteins and the synthesis of muscle glycogen in the liver and muscle (Ivy, 2002).

2.9. Fat and performance of football players

It has often been recognised that training or game intensity is one of the main factors determining the rate of fat utilisation during workouts; and research has also shown that fat utilisation is lower at low intensities (25%VO_2max), compared to moderate intensities (65% VO_2max); and is lower again at high exercise intensities (85% VO_2max) (Achten & Jeukendrup, 2003).

Performance in sports like football is determined partly by the demand of the game and the ability of the body's energy system to deliver the rate and amount of fuel. For prolonged exercise, like distance running, the percentage of sustainable metabolic turnover, the bulk of the available fuel sources, and the body make-up are the factors which influence performance. The main reasons for fat oxidation are the intensity and length of the workout, as well as the diet and exercise status of the athlete (Jeukendrup & Aldred, 2004; Pendergast, Leddy, & Venkatraman, 2000). It is noted that proficient professional players have better fat oxidative ability, which saves glycogen and hence improves performance (Pendergast et al., 2000). While the human body has a limited capacity to store CHOs, endogenous fat depots are large and represent a vast source of fuel for exercise. However, fatty acid (FA) utilisation is restricted, especially during intense workouts, and CHO remains the major energy for oxidative metabolism (Hawley, 1998).

2.10. Fat requirements for football players

Football requires a high aerobic power and endurance, so in considering the effects of dietary fat, consumption has to be measured in light of potential training outcomes (Pendergast et al., 2000). Studies advise that maximum fat oxidation can be beneficial for many individual players. It has also seen, in players after endurance exercise, that the intensity of fat oxidation or metabolism is improved. This correlates with improved performance. It has been pointed out that the capability to metabolise fatty acid is linked to improved performance and that the intensity which stimulates greatest fat metabolism may possibly be enhanced (Achten & Jeukendrup, 2003). So, football players need to consider their training intensity to get something out of fat intake.

It has been confirmed that CHO consumption throughout prolonged activity can increase endurance capability and the metabolism of consumed CHO. However, this is restricted to a level of about 1g/min, probably because intestinal movement mechanisms become saturated at that rate. Research has suggested that an improved supply of exogenous energy during practice can have ergogenic outcomes. Specifically, using medium chain triglycerides that are added to CHO solutions, have been shown to improve performance; but long chain triglycerides do not (Jeukendrup & Sarah Aldred, 2004).

2.11. Hydration and performance of football players

Dehydration is the loss of body water and is often defined in terms of changes in body mass during acute exercise (Baker, 2014 ; Kurdak et al., 2010). Higher work levels are associated with higher levels of metabolic heat creation, as ~75- 80% of energy is changed to heat in the active muscles. At high ambient temperatures (i.e., greater than skin temperature, which is ~33°C at rest and up to ~36°C during exercise), heat is added from the environment, adding to the body's heat load. During exercise, the main mechanism by which heat is expelled from the body is through the vaporisation of sweat from the

skin's surface. This is crucial in controlling body core temperature and may lead to sweating-induced dehydration.

Professional football is highly competitive and challenging, and a minor dehydration can disturb the performance of a player. Dehydrating to the extent of a 2% to 7% loss of body mass consistently decreases endurance exercise performance (Laitano, 2014). Dehydration occurs when a player has lost substantial body fluids and important electrolytes (cellular particles), especially sodium (Carlsen & Marek, 2010; Shirreffs, Sawka, & Stone, 2006). It is important to note that that peak performance may not be achieved without proper hydration (Vanderlei, 2013). Athletes, such as football players, exercising for longer than one hour must drink a formulated sports drink to enhance their performance and recovery. Players practicing during training, or while competing, will benefit by ingesting various mixtures of water, CHOs and electrolytes (Coyle, 2004). During the PI's time with the Ethiopian national football team, this practice was also applied through the preparation of a homemade sports drink using natural honey (two spoons), a pinch of salt and one litre of water. Many investigations have indicated that top football players do not drink an adequate volume to replace their sweat loss during exercise (Mujika & Burke, 2010).

2.12. Hydration requirements for football players

Fluid intake should not be a one-off for a football player; fluid needs to be consumed throughout the game or training period. Football has unique when it comes to hydration, particularly as it does not have regular breaks for players to drink fluids during matches. Water consumption during football is mainly determined by official rest times and, occasionally, during casual stoppages during the game. The current rules for water breaks in football seem unrealistic if the water needs of players playing in warm and humid climates are to be met, thus preventing hypo-hydration and fatigue. Nevertheless, it appears that in most team sports, there are adequate opportunities for players to keep fluid deficits below 2% of body mass. Studies across a number of sports show that mean fluid intakes of up to 1000 ml/h can be achieved (Burke, 1997). Therefore, water requirements, based on the environmental conditions of play need to be met. Fluid intake during exercise

is quite beneficial for players, as it minimises the effects of dehydration, which may cause performance to decline. Players must be educated as to the importance of fluid intake before, during and after exercise (Cristiano Ralo Monteiro, 2003; Maughan & Shirreffs, 2010).

2.13. Micronutrient requirements for football players

Dietary surveys show that a daily diet that includes fruit and vegetables can meet the recommended amount of vitamins and minerals (Maughan, 2006). These micronutrients play an important role in energy production, haemoglobin synthesis, maintenance of bone health, adequate immune function, and protection of the body against oxidative damage (Rodriguez, DiMarco, & Langley, 2009). Vitamins are essential organic compounds that serve to regulate metabolic processes, energy synthesis, neurological processes, and prevent the destruction of cells. Minerals are essential inorganic elements necessary for a host of metabolic processes. Minerals serve as structure for tissue, are important components of enzymes and hormones, and regulate metabolic and neural control (Kreider, 2010). Antioxidant supplementation has been shown to decrease the oxidative stress associated with intense training; however, it does not seem to translate into improvements in athletic performance (Beals, 2013).

There is currently no documented research on the micronutrient intake of Ethiopian football players; hence it is crucial that the micronutrient intake of Ethiopian football players is assessed. Despite the fact that micronutrient intake is vital for players, what remains somewhat controversial is whether athletes have greater micronutrient requirements than their sedentary counterparts, or whether a micronutrient intake exceeding the RDA can enhance performance (Beals, 2013). Currently, Ethiopian football players have a limited intake of fruit and vegetables. Based on his personal experience with Ethiopian football player, the PI learned that there is a misconception that fruits are only eaten when someone gets sick.

2.14. Factors that affect optimal nutrition in football players

Investigations into the dietary behaviour of football players have indicated that the majority do not ingest foods that may be considered well-suited to top physical performance. Such dietary behaviour leaves much room for improvement (Ingram & Davies, 1996; Jesus Rico-Sanz, 1998). Studies in other sports have emphasised many obstacles that have been seen to prevent both elite and sub-elite athletes from following optimally nutritious diets. Lack of nutritional knowhow and lack of nutritional support by well-informed staff in the team have been shown to play their part in players' poor dietary habits (Shifflett, Timm, & Kahanov, 2002).

2.15. Nutrition education for football players

Nutrition education courses for football players are often based on the evidence that greater nutrition knowhow may transform into improved food intake. This concept of awareness translating into practice was highlighted by findings from research using a large community sample in the United Kingdom. It showed a link between nutrition knowledge, improved fruit and vegetable consumption, and reduced fat intake (Heaney, O'Connor, Michael, Gifford, & Naughton, 2011). The right nutrient consumption and decent nutritional knowledge have been documented as playing a critical part in improving football players' performance in terms of enhanced and quality of training and a quick recovery from exercise (Ali, 2015). It is well researched that football is a physiologically challenging game, characterised by uneven changes of leap and anaerobic exertions overlaid on easy-to-moderate aerobic exercise (Murphy & Jeanes, 2006). Given the well-documented importance of nutrition in enhancing performance and health, it is surprising that the nutritional intake of football players has been systematically defined as scanty, which hinders performance. Most studies have reported that day-to-day CHO consumption is lower than that recommended, while the protein and lipid intake of the majority of players exceeds recommended amounts (García-Rovés et al., 2014). Hence, proper nutritional consumption, which adheres to carefully measured amounts of CHO, protein and fats is essential to attain peak performance and recuperate timeously. Based

on working experience with the Ethiopian National Football team, the PI identified that the players tend toward a high protein diet without paying much attention to CHO and fat consumption. It has also been pointed out that the football players, as well as their gurus, teachers and coaches do not understand about the dietary requirements of the players, so nutrition professionals are critically important in the football team (Ali, 2015).

Research has confirmed that nutrient intake is influenced by numerous factors like genetics, the environment, socio-economics and culture. Professional football players often move between countries, and as a result they experience extra problems in adjusting their dietary behaviour to the new local dietary habits. As a result, studies have noted that professional football players habitually fail to consume the ideal sport specific diet (Ono, 2012).

2.16. Alcohol use and football players' performance

According to the World Health Organisation definition, alcoholism is 'drinking that causes emotional, social or physical damage to the individual', and it is usually well designated as 'a social ailment with medical complications' (Lyons, 2000). Alcohol consumption is frequently associated with sport, and the relationship is particularly strong in football. Alcohol continues to be the most frequently consumed drug among athletes and habitual exercisers and alcohol-related problems appear to be more common in these individuals (El-Sayed, 2005). Alcohol has metabolic, cardiovascular, thermoregulatory, and neuromuscular impact that may influence sports performance. Its impact on our judgment, through the central nervous system, results in a deterioration in skill and in behavioural changes that probably negatively affect the performance of football players (Barnes, 2014; Maughan, 2006).

Even though the aim of post-match training or post-match recovery periods and specially adapted workouts is to facilitate physiological procedures that are significant for changing the exercise-induced abnormalities to homeostasis and normal physiological function, many football players are seen consuming large amount of alcohol. This effects their ability to recover properly, to replenish the energy they expend and to repair the muscle

tissue that they have damaged during exercise (El-Sayed, 2005; Parr et al., 2014). Alcohol interferes with myofibrillar protein synthesis in human skeletal muscle during recovery, and even with optimal nutrient consumption; the result if that performance is compromised (Parr et al., 2014).

The influence of alcohol consumption on hydration, and its diuretic properties, are well known and acknowledged. The identification of alcohol as a powerful diuretic date back to 1948, when it was observed that 10 mL more urine was produced following each gram of ethanol intake. The mechanism to explain this was subsequently recognised as the inhibition of the anti-diuretic hormone (ADH) after ethanol consumption, although this association was only in drinks containing more than 4% (w/v) ethanol (Vella, 2010). Alcohol has further been revealed as a peripheral vasodilator, causing numerous problems, mainly by promoting water loss through evaporation which further aggravates the dehydration that is potentially already present. This harms player performance, especially in hot and humid environments and at high altitude (Vella & Cameron-Smith, 2010).

Due to the many and multifaceted mechanisms by which ethanol or alcohol influences physiological systems, it can be confidently concluded that raised blood alcohol concentrations at the time of exercise will weaken the performance of football players (Barnes, 2014).

2.17. Diet and supplementation

Supplement' is a well-used term for vitamins, minerals, herbal remedies, traditional Asian remedies, amino acids and other substances which are taken orally (Petróczi, 2007) They may also be referred to as dietary, food or nutritional supplements or ergogenic aids (supplements purported to improve athletic performance) and are typically sold in the form of tablets, capsules, soft gels, liquids, powders, and bars (Petróczi, 2007). Supplements are not intended to be a food substitute because they cannot replicate all the nutrients and benefits of whole foods. However, the nature of the competitiveness in football, where about 2/3 of the distance covered during a game is at the lower intensity

of walking and jogging, and 1/3 is at sprint speeds, with the remaining at a cruise ("running with manifest purpose and effort" - faster than a jog, but slower than a sprint) may demand the administration of CHO supplementation, (Kirkendall, 2004).

2.18. CHO supplementation during practices and game

The purpose of CHO supplementation during or before a game or practice is to maintain the concentration of blood glucose (Jeukendrup & Gleeson, 2010; Russell, Benton, & Kingsley, 2014), and thereby maintain muscle and liver glycogen. Through this process of CHO supplementation, endurance capacity and performance during practice or a game is improved. Since the 1980s, research has demonstrated the positive effects of CHO supplements. Typically, the benefits are seen during exercise lasting for more than one hour and research has focused on optimising the delivery strategies for these preferably multiple source CHO. (Beals, 2013; Jeukendrup, 2008).

Research has demonstrated that the energy content and osmolality of the ingested CHO solution plays a key role in determining the gastric emptying rate of the solution. Solutions containing a low energy content (low osmolality) empty faster from the stomach than solutions of high energy content (high osmolality). Only solutions with low caloric CHO content should be ingested during football because they empty rapidly to prevent dehydration (El-Sayed, MacLaren, & Rattu, 1997). Gastric emptying is the primary factor limiting the rate of CHO delivery to the blood and therefore influences the utilisation of exogenous CHO ingested before or during exercise (El-Sayed et al., 1997). Research shows that CHO are the first choice of fuel for endurance sports (Jeukendrup, 2007). However, it has been demonstrated that many athletes, especially football players, are consuming below-normal levels and hence supplementation becomes vital. CHO is the body's most limited fuel and the most heavily metabolised during moderate to high intensity exercise (Jacobs, 1999). For this reason, it is recommended that football players consume a minimum of 22g of CHO every hour (Asker Jeukendrup, 2007).

2.19. High altitude nutrition and performance of football players

Fundamental reasons why high altitude influences metabolism includes the hypoxic-hypobaric environment, physical exercise and diet or physiological factors (Hill, Stacey, & Woods, 2011; Levine, Stray-Gundersen, & Mehta, 2008). Predictable metabolic changes at altitude include an augmentation or increase of the basal metabolic rate, lower oxygen availability in the peripheral metabolic tissues, reduction in aerobic capacity, and augmented glucose dependency and lactate accumulation during exercise (Hill et al., 2011). In addition, high altitudes are associated with drier air and the quicker evaporation of sweat. Therefore, the importance of increasing hydration and CHO intake at altitude is widely acknowledged and should be considered by Ethiopian football players/teams that train and compete at altitudes above 2000 meters.

Research has concluded that VO_2max, which is a primary factor in endurance performance, decreases by somewhere between 0.5% and 1% for every 100m increase in altitude above sea level. In endurance-fit football players, endurance performance (subject to intensity) declines somewhat more, at 1.1% to 1.5% for every 100m in altitude. This reduction can be predicted in professional footballers who will either have to pace themselves during a game, or will experience exhaustion (Kayser, 1992; Levine, Stray-Gundersen, & Mehta, 2008). It is also believed that oxidative stress at high altitude may impact the performance of players. This can easily be addressed by a strong anti-oxidant enzyme combination, together with a good day-to-day source of 'sacrificial' antioxidants, such as vitamin C, b-carotene, vitamin E and other anti-oxidant nutrients found in fruit and vegetables (Askew, 2002). Therefore, football players at high altitude must consider their dietary practices to balance the impact of oxidative stress.

Conclusion

This chapter reviewed the literature on the current dietary practices in professional football players. Physiological demands and total distance covered and energy expenditure for different player positions were discussed. Football fatigue was also

addressed together with the effects of macronutrient requirements, dehydration, dietary habits (including nutritional education and alcohol intake) to understand the possible effects on the players performance.

CHAPTER 3. GENERAL METHODOLOGY

This general methodology chapter describes the main materials and instruments that were used in each of the studies included in the thesis.

The three-interlinked studies were conducted on Ethiopian professional football players. The sample population in study 1 was the Ethiopian national football squad during the period 2012 to 2014; while the sample populations for study 2 and study 3 were players from seven different Ethiopian premier league football clubs and one Ethiopian Premier League football club, during the period of 2016, respectively. The Ethiopian Premier League club consisted of twenty players from a recognised top-division club who, at the time, were challenging for the title. All players were over eighteen years of age. The players had schedules that included six training days and one competitive match at the weekend and sometimes another match during the week days.

3.1. Study 1 – Evaluation of the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period of 2012 to 2014

3.1.1. Study participants and data collection

The participants in study 1 were the Ethiopian national football squad who participated in the World Cup qualifying rounds (2012-2014). The data were obtained through careful examination, by conducting semi-structured interviews and focus group discussions with the players and coaches involved with the squad. A one-on-one interview and discussion with each participant was conducted as a means of gathering information about the impact of the nutrition education programme on their overall football performance (DiCicco-Bloom & Crabtree, 2006) and their dietary practices during their tenure in the national squad between 2012 and 2014. The PI found this type of interview best, as the researcher

did not get more than one chance to interview each member of the sample population, and the use of open-ended questions gave a better insight into the research topic. Information collected on the nutrition knowledge of each of the players as well as their responses to the interviews and during the focus group discussions were used to evaluate the impact of a nutrition education programme on the dietary, sports nutrition and supplement practices of the players.

Before collecting data for study 1, permission to conduct the research was obtained from the relevant gatekeeper (**Appendix 1** – See gatekeeper permission letter to conduct the research from the Ethiopian Football Association). Upon receiving ethics approval from the University of KwaZulu-Natal Biomedical Research Ethics Committee, the PI contacted the Ethiopian national football squad and staff and requested an appropriate time to meet the players for an introductory meeting. At that meeting, the PI explained the aims and objectives of the study and associated procedures verbally and in writing via the Participant Information Sheet. Once the participants gave their consent the study was conducted. The interview included twelve pre-determined open-ended questions (Appendix-5 Interview and focus group discussion for national team players and coach), although the interview could develop into a conversation, giving the responders the chance to fully explore topics of interest. Each interview was conducted in a private room in a one-to-one set-up and was scheduled for a duration of approximately sixty minutes, all of which was audio-recorded.

The interview was planned over seven phases: The first phase covered each player's diet and the supplementation practices at their club and whether they have a professional nutritionist. The second phase aimed to gather information about the diet and supplementation practices of team Ethiopia, including the timing of nutrient supplementation, together with the recovery mechanisms and hydration techniques they implemented. The third phase of the interview included questions about physiology: their health and injuries. In the penultimate question, the players were asked to explain their nutrition education programme and discuss macronutrient and micronutrients, in addition to sports drinks and alcohol. In the final phase of the interview, the participants provided insights about their weight management.

3.1.2. Nutrition education programme intervention

It is believed that if we are able to change the mind it is probably easy to change the body (Molina-López et al., 2013b). The method that the PI used to change the dietary and supplementation practices of the Ethiopian national squad was a nutrition education programme for the players and coaches. During the initial stage (1st six months) of the intervention, the PI conducted a nutrition class every day for 30 minutes. Because this kind of intervention was the first of its kind for both the players and coaches, the focus was practical nutrition and the time was limited to 30 minutes to prevent any boredom or a drop-off in attendance. The contents of each session focused on macronutrients, micronutrients, hydration, supplementation and recovery, including the cultural and economic influences that Ethiopian society has on football nutrition. After six months, the PI changed the intervention to once a week for the rest of the period (next 18 months). The PI received encouraging feedback about the programme from the players. The PI found that the role of the coach was immense in making the class more lively and full of fun. This increased the players' participation in class.

3.1.3. Data analysis

An inductive analysis method was used on the qualitative data. All the recorded data were transcribed verbatim in English by the PI. Bearing in mind that research into nutrition in professional football players in Ethiopia is limited, new, unique data was predicted to emerge from the study. The inductive method was used to capture and explain the points of meaning from the extensive and varied raw data gathered from each player's interview responses (Thomas, 2016). The points of meaning were then used to construct a composite summary, with a view to establishing clear links with the original research objectives, namely the retrospective analysis (evaluative case study) of the nutrition education programme for Ethiopian football players from the 2012 - 2014 World Cup Qualifier Squad which had been conducted through interviews with these players.

All the qualitative data obtained from the individual interviews with players, and in the focus group discussions, about the impact of the players' nutrition education programme (which had been implemented by the PI who was with the squad during the period 2012-2014), and relating to the dietary, sports nutrition, recovery, performance, alcohol, health, supplement practices, hydration practices, CHO, protein, fat intake and micronutrients, were analysed thematically using a socio-economic coding matrix, combined with additional themes that emerged from the data (Crowe et al., 2011). Using manual coding methods, the PI adopted Braun and Clarke's guide to the six phases of conducting thematic analysis, by familiarizing oneself with the data, generating initial codes, searching for themes, reviewing them, defining and naming them, and finally producing the report of findings. (Braun & Clarke, 2006). For the descriptive analysis, the Microsoft Excel 2016 program was used to generate the preliminary analysis, comprising bar graphs and pie graphs.

3.2. Study 2 - The dietary intake, sports nutrition and supplementation practices of professional Ethiopian football players currently at Ethiopian Premier League clubs

To study the macronutrient intake and sports nutrition supplementation practices, 18 professional Ethiopian football players at each of seven Ethiopian Premier League clubs were assessed. The aim was to measure dietary intake over a four-day period for 126 players, with post assessment recommendations to optimise dietary support.

Based on the experience of the PI, it has been observed that there are limited resources and a lack of focus on nutrition in Ethiopian football. For these reasons, professional players in the Ethiopian Premier League do not follow optimal dietary, sports nutrition and supplement practices for health and performance (Spriet, 2014). No research has been performed in this area, and hence the purpose of this study 2 was to measure the dietary intake and describe the sports nutrition and supplementation practices of professional Ethiopian football players currently playing at Ethiopian Premier League clubs.

3.2.1. Study participants and data collection

The sports nutrition and supplementation practices of 126 Ethiopian Premier League professional football players (across seven clubs) were assessed. The clubs included in the study were: Adama City, Arba Minch City, Awassa City, CBE, Dashen Beer, Dedebit FC, Defence FC, EEPCO FC, Ethiopian Coffee FC, Muger Cement FC, Saint-George FC, Sidama Coffee FC, Welayta Dicha FC and Woldia City FC.

The dietary intake of the players was observed, weighed and recorded during training and meal times over a four-day period using the weighed intake method (Ferro-Luzzi, 2003). The PI was involved in investigating and weighing each item of food and drink prior to every meal. A detailed description of the food and its weight was recorded in a specially designed booklet (Maughan, 1997). Usually a space was left to record any leftovers so that the precise weight of the food eaten could be precisely calculated (Maughan, 1997). Players were also asked to report additional food or drink intake outside of meal times. Anthropometric measurements taken during the study included height, weight and BMI, so as to estimate percentage body fat and lean muscle mass to be used as descriptive measurements.

Before collecting data for study 2, permission to conduct the research was obtained from the relevant gatekeeper (**Appendix 1** – See gatekeeper permission letter to conduct the research from the Ethiopian Football Association). Upon receiving ethics approval from the University of KwaZulu-Natal Biomedical Research Ethics Committee, the PI contacted the seven clubs, and informed them about the study and the data to be collected. The seven teams were selected, based on their standing in the table during the second round of the season: In March 2016, three were from the top of the table, three were from the bottom and one was from mid-table.

3.2.2. Training research assistants to collect dietary intake data

The PI provided training to research assistants who assisted with the collection of the dietary intake data. These research assistants were from the Adama Science and

Technology University teaching staff and post-graduate students. Regardless of what experience the research assistants had, the training included:

a) an introduction to the purpose of dietary intake assessment;
b) a practical demonstration of the data collection techniques of weighing food and fluids;
c) precise reading of digital or analogue scales;
d) practice in the use of the instruments; and
e) a thorough discussion of ethical issues.

3.2.3. Data analysis

The dietary intake data were analysed using the Nutritics version 4.3 software computer program (Nutritics LTD, Ireland, Dublin). This is a nutrient analysis software system designed specifically to be used by professional dieticians, sports nutritionists and advisors to help them in their task of analysing diets. Total caloric and macronutrient intake of the participants were calculated. Descriptive statistics (mean, standard deviation and 95% confidence limits) were reported and then the quantities were compared between clubs using one-way analysis of variance followed by Bonferroni post-hoc testing. Statistical analysis was performed using SPSS version 24.

3.3. Study 3 - Training load, energy balance, performance and recovery of professional football players

3.3.1. Study participants and data collection

Before collecting data for study 3, permission to conduct the research was obtained from the relevant gatekeeper (**Appendix 1** – See gatekeeper permission letter to conduct the research from the Ethiopian Football Association). The PI contacted Adama FC and informed them about the study. The club were happy to accept the request for them to participate in the study. Selection of the club was based on their willingness to participate in the proposed study. The study was conducted after ethics approval was received from the University of KwaZulu-Natal Biomedical Research Ethics Committee; and once informed consent had been obtained from each of the study participants in the club.

3.3.2. Training research assistants to collect dietary intake data

The PI provided training to the research assistants to assist with the collection of the dietary intake data. These research assistants were from Adama Science and Technology University teaching staff and post-graduate students. Regardless of what experience the research assistants had, the training included:

a) an introduction to the purpose of dietary intake assessment;
b) a practical demonstration of the data collection techniques of weighing food and fluids;
c) precise reading of digital or analogue scales;
d) practice in the use of the instruments; and
e) a thorough discussion of ethical issues.

The dietary intake of the 20 Adama FC football players was carefully measured in the month of October during the pre-season period, which was a period of intense training prior to the main competition season. Seven-day weighed dietary records were used. The dietary intake of the players was directly observed, weighed and recorded. All the players were playing in the Ethiopian Premier League and were living in their private training camp. As usual during the seven-day study period, players were following their normal eating and drinking habits.

The training diary, in combination with direct observation, was used to estimate energy expenditure (EE). Total EE was estimated from the duration and intensity of each activity.

Using physical activity level (PAL) for this study, the PI used the 'very active category' to estimate the energy demand of the participants, which was expressed as intensive exercise for 60 minutes or longer, five to seven days per week, with a stress factor of 2.1 (Schofield, 1985). The energy costs were expressed as a multiple of basal metabolic rate (BMR). During the study, BMR was estimated by using the Schofield equations (Schofield, 1985). The Schofield Calculation permits one to estimate the basal metabolic rate (BMR) in calories, built on a few simple variables: gender, age, and weight. Height is not required. The ultimate result was given as a range and was adjusted upwards or downwards from the calculated value, based on the 'standard error of estimated' or SEE (provided by the author). For participants with a much higher lean body mass (reduced body fat), the upper end of the range was used; while for participants with a higher body fat percentage the lower end of the range was used (Schofield, 1984). The training intensity and EE data were generated indirectly.

Table 3. 1. Schofield - Basal Metabolic Rate equations

Age (years)	**Males**
10-17	BMR=17.686 x (weight kg) +658.2 (SEE = 105)
18-29	BMR=15.057 x (weight kg) +692.2 (SEE = 153)
30-59	BMR=11.472x (weight kg) +873.1 (SEE = 167)
≥ 60	BMR=11.711x (weight kg) +587.7 (SEE= 164)

Source (Schofield, 1984).

Table 3. 2. Schofield - Physical Activity Levels

Activity levels	**Male stress factor**
Sedentary: Little to no exercise. Inactive in both work and leisure.	**1.3**
Lightly active: Intensive exercise for at least 20 minutes once or twice per week, or daily routine includes some walking.	**1.6**

Moderately active: Intensive exercise for at least 20 to 45 minutes 3 to 4 times per week, or a job with a lot of walking, or a moderate intensity job.	**1.7**
Very active: Intensive exercise for 60 minutes or longer, 5 to 7 days per week.	**2.1**
Extremely active: Exceedingly active and/or very demanding activities: athlete with an almost continual training schedule, with multiple training sessions throughout the day.	**2.4**

Source (Schofield, 1984).

3.3.3. Yo-Yo Intermittent Recovery Test level 1

The purpose of Yo-Yo Intermittent Recovery Test level 1 was used to know player's ability to recover from repeated exercise with a high contribution from the anaerobic system which could help to evaluate the effect of training at different positions of play and to conduct this test it require to setup a 20-meter distance by using measurement tape An acoustic signal ("beep") will indicate the speed of running. With the first "beep" the players will start running towards the 20-meter marker and should reach it by the second "beep", which also indicate the players to turn around and run back to the original start. A third "beep" will indicate the finish of one shuttle and all players need to reach the start line by this "beep". All 20 players were trained to be familiar with the testing procedures of the Yo-Yo Intermittent Recovery Test, level 1 (YYIRT1). The post test was administered seven days after the administration of the pre-test. The test consisted of 20 metre shuttle runs, performed at increasing speeds, with ten seconds of active recovery between runs, until the participant yielded to exhaustion (Gumusdag, Unlu, Cicek, Kartal, & Evli, 2013a). The test finished when the participant failed, twice, to reach the front line in time; or felt they were not able to cover another shuttle at the dictated speed (Gumusdag et al., 2013a). Hence, the total distance covered during the YYIRT1 was the primary performance measurement. All field tests were performed on the same football field where players usually trained. Peak velocity (V Yo-Yo) achieved in the YYIRT1 test was calculated by using the formula V Yo-Yo = V + 0.5 X (n / 8) (Gumusdag, Unlu, Cicek, Kartal, & Evli, 2013b). The reliability of the Yo-Yo test was calculated as a coefficient of variation (CV) (4.9%) for the total distance covered during the test (Gumusdag et al.,

2013b). Studies have confirmed that the estimation of VO_2max from the YYIRT1 is valid and reliable. The PI used the following formula for estimating VO_2max (ml/min/kg) from the result of the YYIRT1: VO_2max = distance covered in meters x 0.0084 + 36.4 (Deprez, Fransen, Lenoir, Philippaerts, & Vaeyens, 2015; Mackenzie, 2008; Ermanno Rampinini et al., 2010).

3.3.4. Session RPE

The researcher used the RPE (Rating of Perceived Exertion) scale in the study to obtain a perceptual rating of internal load from each participant after each session and add multiple sessions in a day to obtain the daily TL. This session RPE (sRPE) is a reliable gauge of physical effort that correlates strongly with several other physiological measures of exertion (Day, McGuigan, Brice, & Foster, 2004; Hammouda et al., 2013). The PI trained the study participants how to report their sRPE. Participants understood that appropriate reporting of sRPE, as a measure of internal training load, helps to improve performance and facilitate recovery (Coutts, 2004). Training loads were quantified from a variety of different training modes into one simple arbitrary number by the method of sRPE: 1-10 (Appendix 6). To calculate a measurement of session intensity, study participants were asked, within 30 minutes of finishing their workouts, a simple question: 'How was your workout?' A single number representing the magnitude of the training load for each session was then calculated by multiplying the training intensity by the training session duration (Coutts, 2004).

Table 3. 3. Session RPE Scale

0.	Rest	6	
1	Very, Very easy	7.	Very hard
2	Easy	8	
3	Moderate	9	

4	Somewhat hard	10	Maximal
5	Hard		

Source (Day et al., 2004).

3.3.5. Statistical analysis

Data were expressed as the mean ± standard deviation, following a test for the normality of distribution. A one -way ANOVA, with Bonferroni post hoc testing, were used to examine differences across the seven days for daily energy and macronutrient intake. Paired t-tests were performed to examine differences between pre and post measures for body mass, YYIRT1 distance and time to fatigue as well as predicted VO_2max. Pearson product correlations and multiple linear regression (Backward Method) were used to examine associations between energy balance during the week, physical characteristics and YYIRT1 performance Statistical significance was set at $p \leq 0.05$. All statistical analyses were performed using the software package SPSS, version 24.

CHAPTER 4 RESULTS AND DISCUSSION

This chapter presents the results from, and discussions of, the three inter-linked studies conducted on the Ethiopian national football squad and Ethiopian professional football players participating in the Ethiopian Premier League.

4.1. Study 1 – Evaluation of the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period 2012-2014

Football nutrition is now well established in developed countries, but similar initiatives are rare in Africa. On the African continent, football nutrition services are scarce and often a luxury; although the importance of nutritional services as mandatory in football performance have been widely recognized (Karelis, 2010). Although football nutrition is an important research field in Ethiopia, much of the focus thus far has concentrated on the technical and tactical side of the game. Thus, to provide more holistic knowledge, it has become imperative to evaluate the impact of sports nutrition education programmes. Given the nature of this study, no specific hypotheses were formulated or tested. The most significant results of the first study, the evaluation of the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period of 2012 to 2014, are summarised below, and are presented under four broad phases: The first phase was concerned with the diet and supplementation practices at the club; whether they had access to the services of a professional nutritionist; and to a nutrition education programme. The second phase aimed to gather information about the dietary practices of players during their time in the Ethiopian national team, such as whether their nutrient consumption was in line with the recovery mechanisms and hydration techniques they implemented. The third phase of the interview included questions about physiology; their health and injuries. In the penultimate question, the players were asked about macronutrients and micronutrients, in addition to sports drinks and alcohol.

4.1.2. Phase one

This phase collected data about the backgrounds of the players; the availability of professional nutrition advice, and the impact of sports nutrition education on the nutrition knowledge of the players.

4.1.3. Background characteristics of players

Figure 4.1.1 presents a summary of the background characteristics of the 15 national team players who comprised the final sample of the study. Of the 15 players, 40% were Saint George Football Club players (SGFC); 27% were Dedebit Football Club players (DDFC). The remaining 33% were from other football clubs.

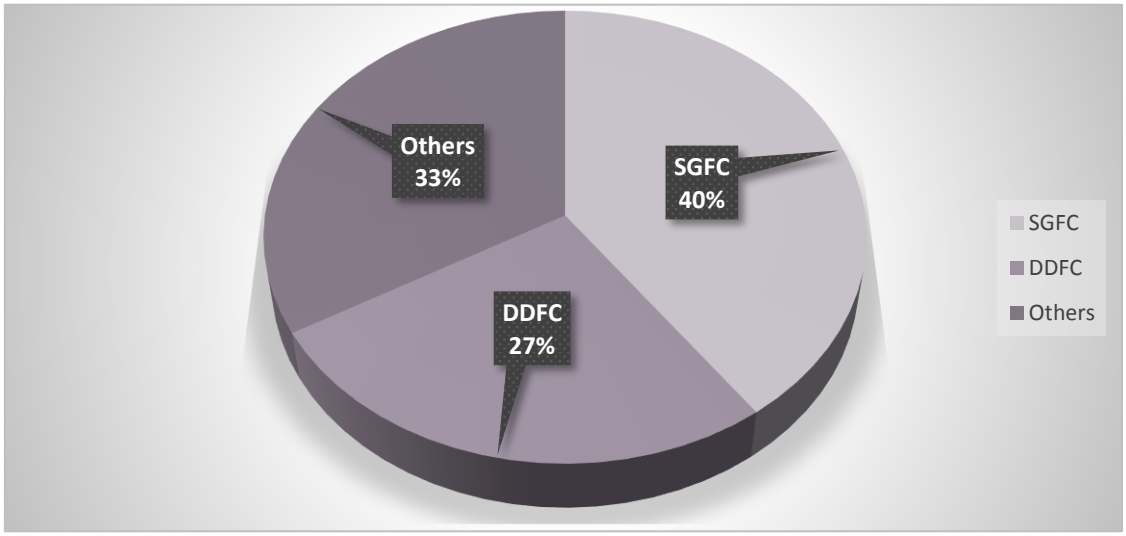

Figure 4.1. 1. Background characteristics of players

Figure 4.1.1 demonstrates the relatively homogeneous background characteristics of the Players most of the players in the national team were recruited from Saint George Football Club (SGFC), followed by Dedebit Football Club (DDFC). Studies have indicated that the heterogeneity of a team does not favour the success of a national football team (Baur & Lehmann, 2007). The homogeneity of the Ethiopian national team might have positively impacted on their success during the period 2012-2014, that is they were able to qualify for the 29th edition of CAF championship in 2013 which was held in South

Africa, and in 2014 they reached the final stage to qualify for the world cup, which was held in Brazil and consequently improves their world football ranking.

4.1.4. Professional nutritionist availability

Figure 4.1.2 shows that 93% of the players had no professional football nutritionist working with them at their club. Only the 7% of the players (who were playing abroad) had access to advice from a professional nutritionist.

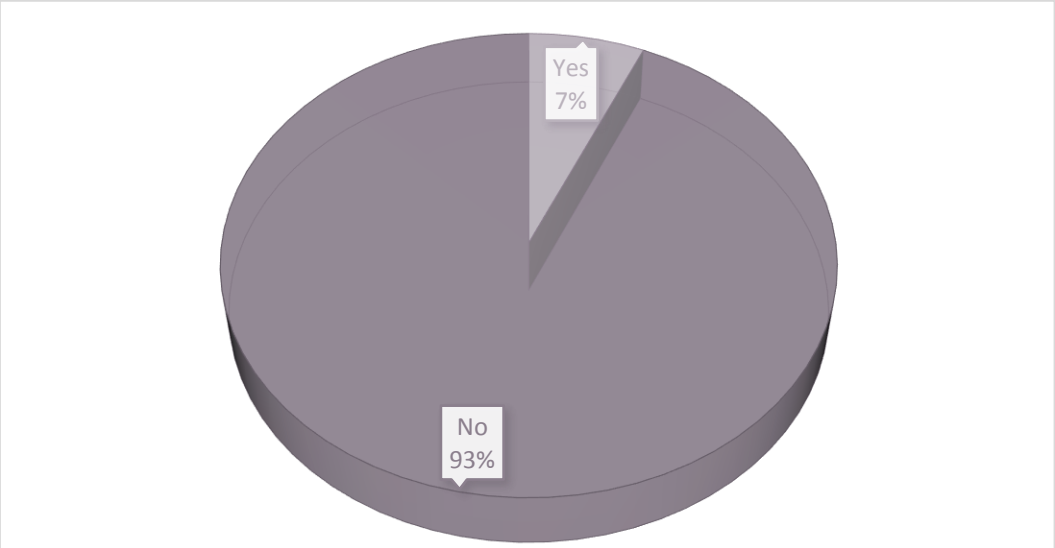

Figure 4.1. 2. Professional nutritionist availability

Figure 4.1.2 shows that Ethiopian national, professional football players not supported by sport nutritionists. This finding runs contrary to current knowledge that the advice of a professional nutritionist is vital for football players (Molina-Lopez et al., 2013), Although many variables must be factored into football performance, the advice and education from sports nutrition professionals is of paramount importance in finding ways to improve overall performance via proper dietary practice (Valliant, Emplaincourt, Kieckhaefer Wenzel, & Garner, 2012). Football players, like any athletes, are always looking for a competitive advantage, often improving nutrition. With the benefit of appropriate nutrition, players can get the most out of workouts, recuperate quicker from training and have less down-time from injury. As a result, more and more professional and college

athletic programmes are signing up sports nutritionists to advance competitive superiority (Thomas, Erdman, & Burke, 2016).

4.1.5. Phase two

This phase examined the responses from the Ethiopian national football players concerning their dietary practices, recovery mechanisms, and hydration techniques, post-exercise physiology, health and injuries during their time in the national team between 2012 and 2014.

4.1.6. Impact of nutrition education.

Figure 4.1.3 presents a nutrition education impact response model which was synthetized from the responses of the players to an interview and focus group questionnaire (Appendix-5) between 2012 and 2014. This thematic synthesis model highlights the impact of nutrition education on the sports nutrition knowledge of the players, with respect to the interventions and respective items probed, as listed below. The expanded major and minor thematic analysis is subsequently reflected and discussed in tables 4.1.1 to 4.1.8.

1. Discussion of nutrition education impact model
2. Knowledge of timing of nutrient consumption
3. Knowledge of recovery
4. Knowledge of hydration
5. Knowledge of post-exercise physiological feeling
6. Injury history of the players between 2012 and 2014
7. Knowledge of macronutrients
8. Knowledge of sports drinks
9. Knowledge of fruit and vegetables
10. Knowledge of alcohol and its impact on performance

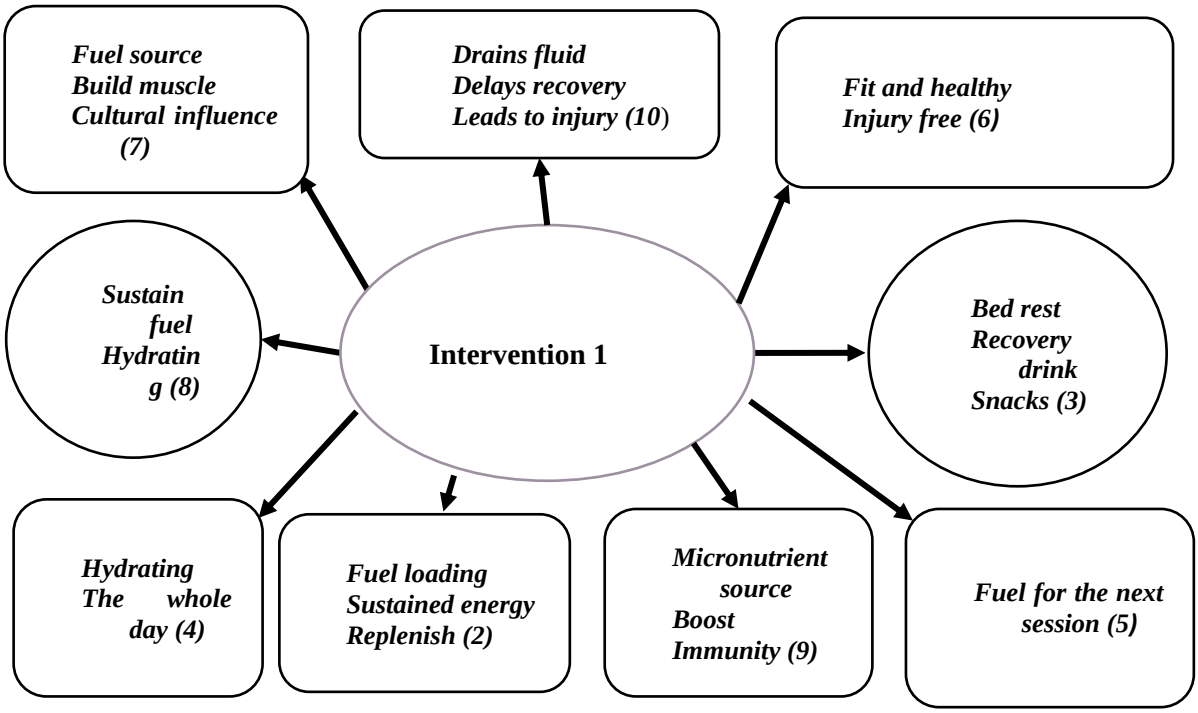

Figure 4.1. 3. Nutrition education impact response model

Figure 4.1.3 summarises the main findings of this study, that sports nutrition education over time improves general nutrition knowledge and understanding, and therefore the dietary choices of players in the Ethiopian national football team. The study proves that additional nutrition education is needed to enhance sports nutrition knowledge (Hawk, 2014). Similar studies have indicated that knowledge of sports nutrition, and consideration of one's own diet, will help to improve personal attitudes towards modifying dietary habits (Murphy & Jeanes, 2006).

4.1.7. Understanding of nutrient timing

Table 4.1.1 summarises the responses to nutrition education by the Ethiopian national team, on the role of pre-, during and post-exercise nutrition practices; that is the timing of nutrient consumption on their football performance and recovery. All players explained that CHO were their pre-workout nutrition, which helped them significantly to load fuel for their workout or practice. The nutritional supplements they were using during practice

or matches helped them to sustain energy and delay fatigue. Players saw the role of post-workout nutrition as refuelling and repairing muscle tissues.

Table 4.1. 1. Understanding of Nutrient Timing

Major-theme	*Minor-theme*
Nutrient timing	*Fuel loading*
	Sustained energy
	Replenishing

(All the major themes are in bold while minor themes are italicized in bold.)

Although, this is the first study to assess the impact of nutrition education on the Ethiopian national team, it is well documented that ideal nutrition can improve football performance (Jessri, Jessri, RashidKhani, & Zinn, 2010). However, many factors can hamper football players from following optimal dietary practices; one of which is the concept of elementary nutrition.

Table 4.1.1 shows the awareness of Players of the importance of nutrient timing in pre-, during and post-workout dietary practice. It highlights their understanding of a positive reaction to training loads. According to studies, the timed ingestion of CHO, protein, and fat may significantly affect the adaptive response to training load (John Ivy, 2004; Kerksick et al., 2008). Most of the Ethiopian national team football players had a sound understanding about fuel loading, especially that in the days before hard training or competition, which the current knowledge of CHO intake recommends 6-10 grams of CHO per kilogram of body weight per day (Burke et al., 2011). Similar studies prove that CHO are a vital source of pre-workout nutrition (Kirkendall, 2004). However, some of the players had misconceptions about fuel loading, often due to incorrect knowledge brought from their clubs and culture (Ono, 2012). Studies have shown that basic nutrition knowledge at club level could play a significant role in building up the nutrition knowledge and dietary habits of football players (Ali, 2015). Depending on the source of nutrition information, it can impact either positively or negatively on the nutrient intake, exercise, training and overall performance of players (Andrews & Itsiopoulos, 2016).

Research has also shown that there is a close association between CHO ingestion and player performance during 'live' football matches (Rollo, 2014). Research has reported that by the time a game or a lengthy workout session ends, those players who have played for the full session will have practically drained their glycogen reserves in their active muscles and liver, delaying a proper and optimal recovery (Reilly & Ekblom, 2005). In the present study, the Ethiopian national football players were well informed about post-exercise dietary practice. They had a good knowledge of recovery nutrition, and replenishing processes, because of the nutrition education they received between 2012 and 2014.

4.1.8. Knowledge of Recovery

Table 4.1.2 summarises the Ethiopian national football players' knowledge about recovery routines after every exercise or game. The responses indicated that they all had good knowledge of recovery mechanisms; that is, the importance of high recovery drinks, complete bed rest and snacks.

Table 4.1. 2. Knowledge of Recovery

Major-theme	***Minor-theme***
Recovery Mechanism	***High recovery fluids intake***
	Complete bed rest
	Snacks

(**All the major themes are in bold, while minor themes are italicized in bold.)**

These responses indicate that the players were knowledgeable about recovery mechanisms. CHO-electrolyte drinks, ('sports drinks') have been recognized to be important in most football-related studies (Ajmol Ali, Williams, Nicholas, & Foskett, 2007). The Ethiopian national team during 2012 to 2014 were using formulated homemade sports drinks and chocolate milk, which was very popular with the players (Kirkendall, 2004). Other research suggests that chocolate milk is a suitable recovery drink

between two exhausting exercise sessions or in an over-filled game schedule (Pritchett & Pritchett, 2012). In addition to consuming homemade sports drinks and chocolate milk, after every training or game players also reported the implementation of post-exercise optimal nutritional intake. Studies proved that when the goal is to optimise repeated exercise capacity following short-term recovery, ingesting carbohydrate at an amount of ≥1.2 gram per kilogram of body weight can maximise muscle glycogen repletion, This significantly helped the players to replenish endogenous substrate supplies and to simplify muscle-damage overhaul and reconditioning (Alghannam, Gonzalez, & Betts, 2018).

From the response of the Players, it is clear that the knowledge they gained from their nutrition education classes helped them quite significantly to be well informed about the physiological benefits of complete bed rest to counter the physical stress experienced after intense training or a match day (Reilly & Ekblom, 2005). Sleep has been identified by top players, coaches, and trainers as a significant feature of the post-exercise recovery procedure, and is believed to be critical for finest performance (Samuels, 2008). According to recent findings, team-sport players are at high risk of having poor sleep during and after competition, particularly if their schedule of play is at night (Fullagar et al., 2015). But in the Ethiopian context, there are no sporting facilities that can allow football matches to be played at night. Even though the responses of the Ethiopian national players to post-workout snacks (which are smaller than regular meals, and generally eaten between meals) are positive and well-informed, some indicated that, in spite of their progress in other areas, they still found it hard to implement, which as a result might affect their energy balance negatively (Burke et al., 2006).

4.1.9. Knowledge of Hydration

Table 4.1.3 shows the Ethiopian national football players' knowledge about hydration and the mechanisms they were implementing to maintain their fluid balance in different

environmental conditions. Most of the players had a sound understanding about the importance of fluids for football performance.

Table 4.1. 3. Knowledge of Hydration

Major-theme	***Minor-theme***
Maintaining fluid balance	***Hydration throughout the day***
	Urine colour as an indicator
	Every 15-20 minutes during workout

(**All the major themes are in bold, while minor themes are italicized in bold.)**

The responses to hydration requirements (Table 4.1.3) indicated that the football players who were members of the national squad during the period 2012 to 2014, had significant knowledge and understanding about the fluid requirements needed for good performance in football. Similar research demonstrated that considerable effort is required to teach players and coaches correct hydration strategies which are relevant to the needs of the sport (Dizon, 2013). This can be achieved through hydration education programmes founded on prevailing guidelines, consisting of the fundamentals of hydration, such as what type and how much fluid needs to be ingested (Ganio, 2018, Dizon, 2013). Nutrition classes given to the Players about hydration greatly assisted the players to comprehend that hydration is not only a one-off practice that they implement during practices or matches. Instead they need to adhere to it during the rest of the day too. Understanding hydration in modern football is of critical importance in overcoming dehydration. Players exposed to warm air stress must consider their hydration status and electrolyte balance before, during and after exercise (Grantham et al., 2010). According to research, the point at which water loss disrupts performance is not yet clearly understood. However, given the ultimate importance of water for the body, dehydration will unavoidably affect performance at some point, and consequently football performance (Benton & Young, 2015). Although it is common practice to use changes in body mass as a guide to changes in body water content, and thus hydration status, the players in the Ethiopian national team were using their urine colour as an index of body water content. This method, using one of the controlling mechanisms of body water content (Shirreffs et al., 2006), is simple and costs nothing. In addition to the above hydration strategies, the Ethiopian national

football team players also benefited from ingesting fluids during their training sessions, at 15 to 20-minute intervals, as a rule. But it was hard to implement this during matches. It is well recognised that players fail to replace their fluid losses fully during non-stop moderate intensity exercise like football (Burke, 1997). However, fluids may be consumed during formal activity breaks, during substitutions and during informal stoppages of play.

4.1.11. Knowledge of post-exercise physiological feeling

Table 4.1.4 summarises the Ethiopian team's responses to questions about their post-exercise or match perceptions of internal load they experienced. Most of the players responded that, after their daily recovery procedure, they were all energetic and fit for the next session.

Table 4.1. 4. Post Exercise Internal Load Perceptions

Major-theme	***Minor-theme***
Feel tired but always energetic for the next session	***Post exercise recovery procedure***

(**All the major themes are in bold while minor themes are italicized in bold.)**

The results of this phase showed that the physiological demands of the game make them feel tired after the workout or match, however the players felt recovered for each new session. Research has shown that in professional football, players are continually required to play successive matches interspersed by only a few days; and peak physical performance cannot be sustained (Nedelec et al., 2012). But most players of the Ethiopian national team during the period 2012 to 2014 indicated that their recovery procedure (mentioned in Table 4.1.2., above) helped them to be energetic for the next workout or match (Rahnama, Reilly, Lees, & Graham-Smith, 2003). This may have been due to the impact of their nutrition education classes which convinced players to strictly follow recovery procedures. Similar studies note that at higher performance levels, football

players need to eat post-game meals that deliver nutrients that will preserve health and well-being, replacing the fuel that was consumed during the game (Berning, 2015). This body of knowledge demonstrates the significance of nutrition education in obeying proper recovery procedures after any workout, for a football player to be fit for the next session or game.

4.1.12. Injury history of the players between 2012 and 2014

Figure 4.1.4. shows the injury history of the players over the period 2012-2014, with an injury defined as the inability to continue with a match or training session. Most of the players (67%) of the players were injury free, while33% did incur some form of injury. Of these injuries 20% were of an acute (caused by some precipitating event) soft tissue nature, but minor in severity leading to a loss of only 2 days of participation. The remaining 13% of the injuries, were of a chronic overuse nature, but lead to a more significant time loss of 21 days or more from participation.

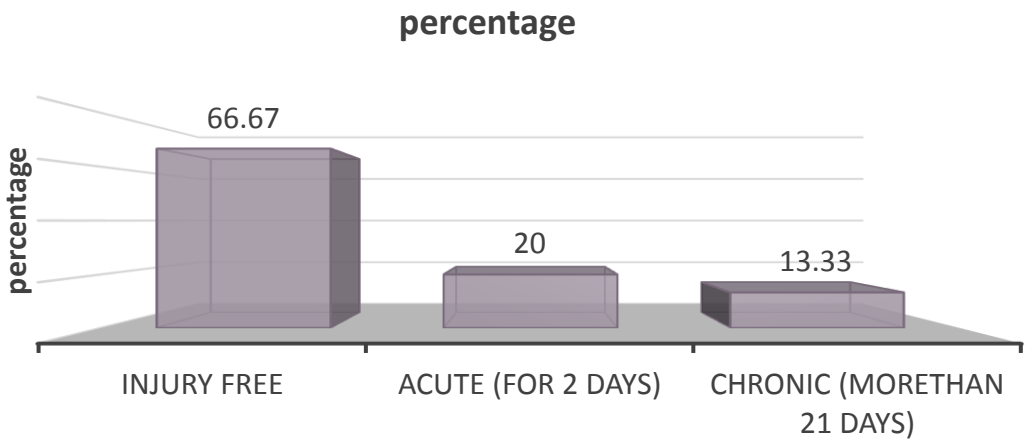

Figure 4.1. 4. History of injury between 2012 and 2014

Whilst it is acknowledged that injury prevention mechanisms are multi-faceted, the Ethiopian national football team players nutrition education may have contributed to this

low incidence of injuries. This statement is supported by the findings that proper nutritional strategy and awareness can minimize sports injury incidence (Medina, 2014). Other similar studies reported that better education of coaches and players regarding injury prevention strategies given by a physician, and correct nutrition and hydration education given by the sports nutritionist are vital in preventing football injuries (Berkes, 2006). Optimal dietary practice and appropriate recovery were strictly implemented in the prevention of injuries in the Ethiopian national team during the period. Such practical knowledge from the Ethiopian national team may be useful for Premier League clubs in Ethiopia.

4.1.13. Phase three

This phase considered the responses of the Ethiopian national football players to questions about macronutrients, micronutrients, sports drinks and alcohol.

4.1.14. Knowledge of macronutrients

Table 4.1.5 shows the Ethiopian national football players' responses about macronutrients. Most of the players reflected that macronutrients are a key factor in their football performance, providing them with appropriate energy and helping them to rebuild muscle tissue damaged by strenuous exercise in training and competition; despite the challenge of cultural influences.

Table 4.1. 5. Knowledge of Macronutrients

Major-theme	***Minor-theme***
Key for performance	***Fuel source***
	Muscle building
	Cultural influence

(All the major themes are in bold while minor themes are italicized in bold.)

Table 4.1.5 reveals that the Players were aware of the significance of macronutrients in optimising football performance; particularly CHO as a preferred fuel source. Similar studies also support the significance of CHOs as a major fuel source for a professional football players (Ingram & Davies, 1996). Nutrition education intervention plays a huge role in helping the players understand the importance of macronutrients, and CHO in particular. Other similar research also confirms that knowledge about appropriate nutritional intake, containing a variety of nutrients and sufficient amounts of energy, is important to supply the required fuel to a professional football player (Murphy & Jeanes, 2006). That is why nutrition education for the players targeted improving their knowledge first; then improving their dietary intake and, finally, improving their performance (Susan Heaney, 2011).

These responses also indicated that the players were well informed about the role of dietary protein in rebuilding muscles which are damaged because of the stress of training. Earlier research has demonstrated that the planned intake of protein improves the adaptive response to exercise and helps increase protein synthesis for muscle building or maintenance of muscle mass (Kerksick et al., 2008). Even though this knowledge will help to implement regular nutrition education for professional football players in Ethiopia, the players admitted how cultural influence was a challenge to their dietary practice, as they were living in a society that labelled eating meat regularly as an expression of wealth and high class (Seleshe, Jo, & Lee, 2014). Studies have confirmed that appropriate follow-ups and counselling by sports nutrition professionals will be paramount in overcoming cultural influences which may interfere with players' proper dietary intake (Martin, 2015).

4.1.15. Knowledge of sports drinks

Table 4.1.6 reflects the knowledge of the players about sports drinks. Most of the players responded that sports drinks are vital in maintaining their football performance during workouts, by providing an uninterrupted supply of fuel. Their responses also confirmed

that sports drinks are quite important for recovery after workouts; in addition to keeping them hydrated.

Table 4.1. 6. Knowledge of Sports Drinks

Major-theme	***Minor-theme***
Maintains performance	***Sustained fuel supply***
	Post-workout recovery
	Keep hydrated

(All the major themes are in bold while minor themes are italicized in bold.)

The results of the present study clearly show the impact of nutrition education on the Players, regarding their consumption of sports drinks. This result is also supported by studies conducted on football played in hot environments, where the advice is for players to be well hydrated. Players should consider their hydration status and electrolyte balance before, during and after exercise (Grantham et al., 2010). Because of the impact of nutrition education, the Players noted the physiological benefits they acquired from sports drinks; being able to maintain their performance and overcoming the stress of training and competition. This result was also supported by the current knowledge of hydration which states that ingestion of formulated sports drinks during exercise will positively affect players' performance (Russell, 2014). Other studies suggest that adequate CHOs should be ingested to supply the blood with exogenous glucose late in exercise (~1 g/min), preferably in the form of sports drinks (Coyle, 1995). The results of the present study showed that the players were well informed about the positive impact of sports drinks on their post-workout recovery routines, helping them to be ready for the next session. This result is reflected in the literature where it is accepted that, during a match, or when an extended exercise session ends, players who had played for the full duration or trained hard will be practically depleted of their glycogen supplies in active muscles and the liver (Reilly & Ekblom, 2005). Hence, sports drinks are vital in replenishing glycogen and rehydrating after the loss of fluid during exercise.

4.1.16. Knowledge of fruit and vegetables

Table 4.1.7 reflects the knowledge of the players about fruit and vegetables. Almost all the players responded that fruit and vegetables are critically important in preventing the stress of exercise; as well as boosting their immunity.

Table 4.1. 7. Knowledge of Fruit and Vegetables

Major-theme	***Minor-theme***
Prevent the stress of exercise	***Source of vitamins and minerals***
	Boosts immunity

(All the major themes are in bold while minor themes are italicized in bold.)

The emphasis of this study was to evaluate the impact of nutrition education on the knowledge of the players about the benefits of fruits and vegetables. Many of the players were remarkably well informed about the importance of regular consumption of fruit and vegetables in preventing the stress of exercise on their bodies and neutralising sub-deficiencies. The findings of this study are substantiated by similar studies, where players had a good knowledge of fruit and vegetables and were able to meet their micronutrient requirements (Volpe, 2007). Another study reported that a well-established knowledge of the importance of regular consumption of fruit and vegetables enabled athletes to obtain the required antioxidant levels in the body (Tauler et al., 2008). This knowledge is highly significant for the Ethiopian professional football players for if they strictly adhere to a regular consumption of fruit and vegetables this will help in their recovery, performance and health.

4.1.17 Knowledge of alcohol and its impact on performance

The information in Table 4.1.8 reflects the knowledge of the players about alcohol consumption and its detrimental effect on their performance and recovery. Almost all the players were well informed about how alcohol drains their bodily fluids and delays their recovery after workouts.

Table 4.1. 8. Knowledge of Alcohol and its Impact on Performance

Major-theme	***Minor-theme***
Detrimental to performance and recovery	***Drains fluid from the body***
	Deters recovery

(All the major themes are in bold while minor themes are italicized in bold.)

The results of this study show the impact of the nutrition education on the understanding of the players about the damaging effect of alcohol consumption on their performance and recovery. Similar studies reported that there is a need to improve the understanding of football players about alcohol consumption, because athletes may not consider alcohol as a substance that harms their sporting performance (Barnes, 2014). Studies have confirmed that alcohol drinking is usually associated with sport, and the association is particularly strong in football, where alcohol undeniably has negative consequences on the performance and recovery of the players (Maughan, 2006; Parr et al., 2014). Besides gaining an understanding of the negative effects of alcohol consumption, football players of the Ethiopian national team also benefited by improving their understanding of personal dietary intakes. These proper dietary practices can in turn lead to an improvement in the football players' physical condition, provide better protection against injuries, facilitate faster recovery, maintain growth and ultimately produce better performance on the pitch. Initially, many of the players believed that alcohol had an ergogenic effect on their performance, but after learning about the negative impact through education, they understood that alcohol is not a performance enhancing

substance. This was highlighted in a similar study which found that athletes, in general, may not consider alcohol detrimental in the same way as they regard other recreational drugs. Therefore, educating athletes or football players, and others in the team, is required (Barnes, 2014). This knowledge, changing players' attitudes through education, will be useful in Ethiopian football.

4.2. Study 2 - The Dietary Intake, Sports Nutrition and Supplementation Practices of Professional Ethiopian Football Players currently playing at Seven Ethiopian Premier League Clubs.

Eating the right balance of food and drink is important for everyone. Those actively participating in sport on a regular basis need to be conscious that it can also affect their performance. Football players, for example, may need more calories than the typical person because of the physiological demands of the game. So, for a professional football player, or simply someone who's made the decision to start exercising on a regular basis, a good nutrition plan must be a priority. To provide a more comprehensive guide for nutrition among Ethiopian footballers, it was essential to measure dietary intake and record the nutrition and supplementation practices of professional Ethiopian football players playing at seven Ethiopian Premier League clubs. The most significant results of the second study are summarized below.

4.2.1. Demographic data (age, height, weight, BMI) compared across playing positions

Table 4.2.1 shows the mean physical characteristics of the professional Ethiopian football players from the seven Ethiopian Premier League football clubs. A one-way analysis of variance (ANOVA) was performed, followed by Bonferroni Post-hoc testing, to compare the demographic characteristics of players. There were significant difference between the players' physical characteristics at the $p < 0.05$ level of significance. The mean age of goalkeepers $M = 28.1$, $\pm SD = 2.2$ years was significantly different $p = 0.012$ compared with the mean age of midfielders $M = 26.6$, $\pm SD = 3.4$ years. Similarly, the defenders'

age *M* = 27.5, ±SD = 2.8 years was significantly p = 0.039 different compared with midfielders' age *M* = 26.6, ±SD = 3.4 years. However, there was no significant difference between the mean ages of defenders and attackers. The mean weight for goalkeepers *M* = 78.5, ±SD = 7.1 kg. Was found to be significantly p < 0.001 different, compared with all other positions; with *M* = 73.6, ±SD = 5.2 kg., *M* = 68.4, ±SD = 7.0 kg., *M* = 73.0, ±SD = 7.0 kg. for defenders', midfielders', and attackers' weights, respectively. Similarly, the mean weights of defenders and attackers *M* = 73.6, ±SD = 5.2 kg., *M* = 73.0, ±SD = 7.0 kgs. P < 0.001, respectively, were significantly p < 0.001 different compared with the weight of midfielders *M* = 68.4, ±SD = 7.0 kg. However, there were no significant weight difference identified between defenders and attackers, but goal keepers are significantly heavier than midfielders

The mean heights of goalkeepers *M* = 1.82, ±SD = 0.7, p = 0.045 cm, *M* = 1.82, ±SD = 0.7, p = 0.005 cm were significantly different compared with the mean height of defenders and midfielders *M* = 1.77, ±SD = .06 cm, *M* = 1.75, ±SD = .07 cm, respectively. Likewise, the mean body mass index of goalkeepers *M* = 23.7, ±SD = 1.3, p = 0.028 kg/m^2 was significantly different compared with that of midfielders *M* = 22.3, ±SD = 1.6 kg/m^2. There was also a significant difference between defenders' *M* = 23.5, ±SD = 1.4, p < 0.001 kg/m^2 and midfielders' BMI *M* = 22.3, ±SD = 1.6 kg/m^2.

Table 4.2. 1. Mean (±SD) Physical Characteristics across Playing Positions

	Goalkeeper	Defender	Midfielder	Attacker
Age (years)	28.1 (2.2) *	27.5 (2.8)	26.6 (3.4) *	27.1 (3.2)
Weight (kg)	78.5 (7.1) *	73.6 (5.2) *	68.4 (7.0) *	73.0 (7.0) *
Height (cm)	1.82 (.07) *	1.77 (.06)	1.75 (.07) *	1.77 (.05)
BMI	23.7 (1.3) *	23.5 (1.4)	22.3 (1.6) *	23.2 (1.6)

*p < 0.05 level of significance for age, weight, height, BMI across playing positions

The results of this study confirmed that the Ethiopian premier league football players were within the peak age curve. Football players peak around their mid-20s; specifically, between 25 and 27 years of age, depending on playing position (Dendir, 2016). A similar study also supports the Ethiopian premier league football players' positional age curve, where midfielders are the youngest and goalkeepers are the oldest. Ranking from the most to the least 'age-sensitive' positions gives: midfielders, attackers, defenders, and goalkeeper (Caley, 2017). The result show that the key physical characteristics of Ethiopian premier league football players across playing positions were like the key physical characteristics of other successful professional footballers, with goalkeepers, central defenders and strikers being taller and heavier than players playing in the midfield. Differences in BMI between playing positions indicated that midfielders tend to have less weight relative to their height (Nevill, Holder, & Watts, 2009). This knowledge will be very important for Ethiopian football players in the lower divisions.

4.2.2. All macronutrient data in grams and energy intake in calories compared across playing positions

Table 4.2.2 shows the mean values for macronutrient intake in grams, and energy intake in calories, across playing positions for professional Ethiopian football players current playing at seven Ethiopian Premier League clubs. A one-way analysis of variance (ANOVA) was used, followed by Bonferroni Post-hoc testing, to compare both the macronutrient intake in grams and energy intake in calories, across the playing positions of the players. Of the four categories, protein intake in grams, CHO intake in grams, fat intake in grams, and energy intake in calories, only protein and fat intake (in grams) were significantly different ($p < 0.05$) between the attackers and the midfielders.

The mean values for the attackers' protein intake in grams (M = 181.8, ±SD = 53.5, p = 0.006) were significantly different compared with the midfielders' protein intake in grams (M = 160.0, ±SD = 45.4) Similarly, the mean values for the attackers' fat intake in grams

(M = 120.4, ±SD = 50.1, p = 0.007), were also significantly different when compared with the midfielders' fat intake in grams (M = 102.0, ±SD = 37.9).

Table 4.2. 2. Mean (±SD) Macronutrient and Energy Intake across Playing Positions

	Goalkeeper	Defender	Midfielder	Attacker
Protein in gm	181.7 (56.6)	172.0 (54.6)	160.0 (45.4) *	181.8 (53.5) *
Carb in gm	343.4 (128.7)	321.4 (103.1)	332.9 (105.4)	317.8 (81.2)
Fat in gm	114.6 (50.2)	110.66 (43.5)	102.0 (37.9) *	120.4 (50.1) *
Energy intake	3131.6 (838)	2969.3 (722)	2888.6 (683)	3081.9 (647)

*P < 0.05 level of significance

The results of the present study indicated that attackers in the Ethiopian Premier League consumed significantly more protein and fat than midfielders. This may affect the performance expected from midfield players who typically display a higher work rate than forwards during matches (Meredith et al., 1989). This mismatch of macronutrients based on players' position of play in the Ethiopian Premier League may be due to the absence of a professional nutritionist and nutrition education for the players (Andrews & Itsiopoulos, 2016; Holway & Spriet, 2011).

4.2.3. Percentages of macronutrient intake across playing positions

Table 4.2.3 shows the mean values for the percentages of macronutrient intake across playing positions for professional Ethiopian football players from seven Ethiopian Premier League clubs. A one-way analysis of variance (ANOVA) was conducted followed by the Bonferroni Post-hoc testing, to compare percentages of macronutrient intake of the players across playing positions. Of the three categories, percentage of dietary protein intake, percentage of dietary CHO intake, and percentage of dietary fat

intake, only the percentage of CHO intake was significantly different at the $p < 0.05$. Results showed that the mean values for the midfielders' percentage of CHO intake M = 46.3, ±SD = 10.1, p = 0.025 was significantly different compared with that of attackers M = 42.4, ±SD = 11.4.

Table 4.2. 3. Mean (±SD) Percentage of macronutrient intake across playing positions

	Goalkeeper	Defender	Midfielder	Attacker
Protein percentage	23.15 (4.2)	23.1 (4.3)	22.1 (3.6)	23.4 (4.2)
CHO percentage	44.4 (12.0)	43.8 (10.1)	46.3 (10.1) *	42.4 (11.4) *
Fat Percentage	32.4 (10.0)	33.1 (8.5)	31.5 (8.4)	34.2 (10.0)

*P: = 0.025 compared with attackers

The findings indicate that midfield players in the Ethiopian Premier League consume significantly more CHOs than attackers. The mean percentage values for CHO intake were not in agreement with the recommended amounts (M = 46.3, SD = 10.1 % vs the recommended 55–60%) and were inadequate (Ruiz et al., 2005). Hence, the midfield players may face difficulty in maximising muscle glycogen stores (JesÚs Rico-Sanz et al., 1998), because the right amount of CHO can be significant factor in the recovery of the muscle and liver glycogen stores after training and competition (Maughan, 1997). The reason for the lower-than-recommended CHO consumption of the Ethiopian premier league football players could be due to their higher consumption of dietary protein, as it is seen in Table 4.2.3 (Seleshe et al., 2014). In addition, the clubs failed to implement proper nutritional practice by a professional nutritionist (Clark, 1999; Holway & Spriet, 2011).

4.2.4. Macronutrient intake, per kilogram of body weight, across positions

Table 4.2.4 shows the mean values for macronutrient intake, per kilogram of body weight, across playing positions for professional Ethiopian football players in the Premier League. A one-way analysis of variance (ANOVA) was conducted, followed by Bonferroni Post-hoc testing, to compare macronutrient intake per kilogram of body weight across playing positions. Of the three categories, dietary protein intake per kilogram body weight, dietary CHO intake per kilogram body weight, and dietary fat intake per kilogram body weight, only CHO intake per kilogram body weight were significantly different $p < 0.05$. The mean values for the midfielders' CHO intake per kilogram of body weight $M = 4.9$, ±SD = 1.5, $p = 0.005$ was significantly different compared with the defenders' CHO intake per kilogram of body weight $M = 4.4$, ±SD = 1.4 Similarly, the midfielders' CHO intake per kilogram body weight $M = 4.9$, ±SD = 1.5, $p = 0.024$ was also significantly different compared with the attackers' CHO intake per kilogram of body weight. But there was no significant difference detected with the goalkeepers.

Table 4.2. 4. Mean (±SD) Macronutrient intake per kilogram of body weight across positions

	Goalkeeper	Defender	Midfielder	Attacker
Protein /kg	2.3	2.3	2.4	2.5
	(.8)	(.8)	(.7)	(.8)
CHO /kg	4.4	4.4	4.9	4.4
	(1.6)	(1.4) *	(1.5) *	(1.1) *
Fat /kg	1.5	1.5	1.5	1.7
	(.7)	(.6)	(.6)	(.7)

*P< 0.005 compared with Defenders, *P =0.024 compared with attackers.

The results of the current study showed that midfielders in the Ethiopian Premier League consumed significantly more CHO per kilogram of body weight compared with defenders and attackers, which sounds reasonable to meet the demands of the game. However, the mean values for CHO intake did not meet the recommended amounts (4.9,

±SD = 1.5 g/kg of BW vs the recommended 7–12g/kg of BW) and were generally low for daily moderate to heavy endurance activities (Burke, Kiens, & Ivy, 2004). A similar study also recommended 6 -10 g/kg of body weight of CHO, which the Ethiopian players failed to meet (Burke et al., 2011). The reason for the lower-than-recommended dietary CHO intake of the Ethiopian Premier League football players could be due to their higher consumption of dietary protein, as it is shown in Table 4.2.4. It may also be ascribed to the clubs' failure to implement proper nutritional practices guided by professional nutritionists (Clark, 1999; Seleshe et al., 2014). This knowledge may help Ethiopian football clubs at all levels to look at their nutritional practices critically

4.2.5. Macronutrients intake in grams, and energy intake in calories, across the four days

Table 4.2.5 shows the mean values for macronutrient intake in grams, and energy intake in calories, for professional Ethiopian football players in seven Ethiopian Premier League clubs across the four days (Monday to Thursday). A one-way analysis of variance (ANOVA) was conducted, followed by Bonferroni Post-hoc testing, to compare both the macronutrient intake in grams and the energy intake in calories, across the four days. Of the four categories, dietary protein intake in grams, dietary CHO intake in grams, dietary fat intake in grams, and energy intake in calories, only dietary CHO intake across the four days was significantly different $p < 0.05$. The mean values for Thursday's CHO intake $M = 344.6$, ±SD = 12.5, $p = 0.030$ grams was significantly different compared with Monday's CHO intake $M = 308.3$, ±SD = 96.4 grams.

Table 4.2. 5. Mean (±SD) Macronutrient intake in grams and energy intake in calories across the four days

	Monday	Tuesday	Wednesday	Thursday
Protein	167.6	170.7	166.7	180.7
	(47.1)	(59.9)	(46.0)	(55.6)
CHO	308.3	332.0	320.1	344.6

	(96.4) *	(98.7)	(89.0)	(12.5) *
Fat	115.0	106.5	105.3	114.4
	(45.7)	(43.3)	(39.6)	(48.4)
Energy intake	2946.9	2969.3	2895.2	3130.8
	(677)	(799)	(611)	(731)

*P< 0.030 compared with Monday

The result of this study revealed that the Ethiopian Premier League football players consumed more dietary CHO on Thursday than on the rest of the study days. However, it was still lower than the recommended 344.6 g/day, SD=12.5 vs 500-600 g/day, (Ruiz et al., 2005). Nevertheless, consuming relatively more CHOs on Thursday, which is closer to match day in the Ethiopian Premier League, was a positive move by the Ethiopian football players (Anderson et al., 2016). However, the Ethiopian players did not adapt their CHO consumption on a daily basis to ensure adequate fuel for training and recovery between matches (Burke et al., 2006). The mean daily CHO consumption of Ethiopian football players does not even rival the daily CHO intake (354 grams per day) of Scottish Premier League football players, which was studied 20 years ago (JesÚs Rico-Sanz et al., 1998; Maughan, 1997). The main reasons for this lower CHO consumption among the Ethiopian football players could be the absence of counselling by professional nutritionists in the Ethiopian Premier League clubs, as well as cultural influences to consume more animal protein (Clark, 1999; Seleshe et al., 2014; Shattuck, 2001).

4.2.6. Percentages of macronutrient intake across the four days

Table 4.2.6 shows the mean percentage values for macronutrient intake for the professional Ethiopian football players across the four days. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc testing, to compare percentages of macronutrient intake across the four days (Monday to Thursday). Of the three categories, daily percentages of dietary protein intake, daily percentages of dietary CHO intake, and daily percentages of dietary fat intake, only daily percentages of dietary fat intake were significantly different $p < 0.05$ The mean value for daily percentages of

dietary fat intake of players on Monday *M* = 34.7, ±SD = 9.4, p = 0.027 percent was significantly different compared with players' Tuesday's daily percentage of dietary fat intake *M* = 31.5, ±SD = 8.1 percent.

Table 4.2. 6. Mean (±SD) Percentage of macronutrient intake across the four days

	Monday	Tuesday	Wednesday	Thursday
Protein	22.6	23.0	23.0	23.0
	(3.3)	(5.3)	(3.8)	(3.7)
CHO	42.7	45.6	44.6	44.4
	(10.7)	(9.8)	(9.9)	(12.0)
Fat	34.7	31.5	32.4	32.6
	(9.4) *	(8.1) *	(8.5)	(9.7)

*P< 0.027 compared with Tuesday

This result from the present study shows that the mean daily percentage of dietary fat intake of the players was significantly higher on Monday (34.7, SD = 9.4% vs 31.5, SD = 8. percent) than on Tuesday. The dietary fat intake of the players was higher than the maximum recommended intake which is 30 percent per day (Pendergast, 2000). Hence, it is not in line with the current recommendation, although higher consumption of dietary fat after competition or heavy training may facilitate faster recovery (Williams, 1995). Consuming relatively more dietary fat on Monday, which is after a match in the Ethiopian League, was a positive practice, because fat metabolism is probably very significant, especially during times of recovery after high-intensity workouts (García-Rovés, et al., 2014). Higher consumption of dietary fat may be due to a lack of nutrition knowledge on the part of the players in the Ethiopian Premier League, because there is a positive correlation between nutrition knowledge and proper dietary intake. Additionally, socio-cultural attitudes towards eating more animal protein in Ethiopian society (Onoa, 2012; Seleshe et al., 2014; Heaney, 2011) could have impacted proper dietary intake.

4.2.7. Macronutrient intake, per kilogram of body weight, across the four days

Table 4.2.7 shows the mean values for macronutrient intake, per kilogram of body weight, across the four days (Monday to Thursday), of professional Ethiopian football players at seven Ethiopian Premier League clubs. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc testing, to compare macronutrient intake, per kilogram of body weight of the players, across the four days. Of the three categories, dietary protein intake per kilogram of body weight, dietary CHO intake per kilogram of body weight, and dietary fat intake per kilogram of body weight, only dietary CHO intake per kilogram of body weight was significantly different $p < 0.05$. The mean values for Thursday's dietary CHO intake per kilogram of body weight was found to be significantly different, at $M = 4.8$ ±SD =.7, $p = 0.025$, when compared with Monday's CHO intake per kilogram of body weight $M = 4.3$, ±SD = .3. But there was no significant difference detected with dietary CHO intake per kilogram of body weight on Tuesday and Wednesday.

Table 4.2. 7. Mean (±SD) Macronutrient intake per kilogram of body weight across the four days

	Monday	Tuesday	Wednesday	Thursday
Protein /kg	2.3	2.4	2.3	2.5
	(.7)	(.9)	(.7)	(.8)
CHO /kg	4.3	4.6	4.5	4.8
	(.3) *	(.3)	(.3)	(.7) *
Fat /kg	1.6	1.5	1.5	1.6
	(.7)	(.6)	(.6)	(.7)

*P < 0.025 compared with Monday

The result of the current study on macronutrient intake per kilogram of body weight across the four days, shows that the Ethiopian Premier League football players consumed

significantly more dietary CHO per kilogram of body weight on Thursday, with the mean daily value of (4.8 g/kg of BW, ±SD =.7). But this value is not in agreement with even the minimum recommended range of 7 - 10 g/kg of BW/day (Burke et al., 2011). This lower dietary CHO intake will not help players to cope with the demands of the game (García-Rovés, et al., 2014). This may be due to a lack of opportunities in the Ethiopian Premier League clubs to obtain nutrition education. Also, higher protein consumption, as is seen in this study, may affect CHO intake negatively. In addition, cultural influences play a role, as eating animal products is seen as a high-class practice in Ethiopian society (Oniang'o, 2003; Ingram, 1996).

4.2.8. Macronutrients intake in grams, and energy intake in calories, across clubs

Table 4.2.8 shows the mean values of macronutrient intake in grams, and energy intake in calories, across the seven Ethiopian Premier League football clubs. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc testing, to compare the mean values of both the macronutrient intake in grams and energy intake in calories. All four categories, that is daily dietary protein intake in grams, daily dietary CHO intake in grams, daily dietary fat intake in grams, and daily energy intake in calories, were significantly different $p < 0.05$.

The mean values of ARMKFC players daily dietary protein intake in grams $M = 221.6$, ±SD = 45.8, $p < 0.001$, was significantly different compared with all clubs (table 4.2.8.), and especially it was highly significant compared with HADYA football club and DDFC players daily dietary protein intake $M = 136.4$, ±SD = 40.6, $M = 139.4$, ±SD = 33.6 respectively.

The mean value of SGFC players daily dietary CHO intake in gram $M = 459.9$, ±SD = 104.1, $p < 0.001$ was significantly different compared with all clubs, (table 4.2.8.) and

especially it was found to be highly significant compared with clubs like HADYA M = 256.0, ±SD = 58.5), *M* = 291.9, ±SD = 108.5 and *M* = 292.2, ±SD = 49.6, respectively.

The mean values of ARMKFC players daily dietary fat intake in gram *M* = 168.3, ±SD = 43.3, p < 0.001 was significantly different compared with all clubs, (table 4.2.8.) and especially it was found to be highly significant compared with clubs like DDFC, *M* = 79.6, ±SD =2 5.1 and *M* = 90.3, ±SD = 36.5, respectively. The mean values of ARMKFC and SGFC players daily energy intake *in* calories *M* = 3569.5, ±SD = 595.9, p < 0.001 and SGFC *M* = 3551.2, ±SD = 595.6, p < 0.001, were significantly different compared with all clubs (table 4.2.8.), especially it was highly significant compared with HADYA players *M* = 2382.8, ±SD = 552.5.

Table 4.2. 8. Mean (±SD) Macronutrients intake in grams and energy intake in calories across clubs

	DASHF	HADYA	ARMKF	CBEFC	ADAF	DDFC	SGFC
Pro.	185.2 (54.3) *	136.4 (40.6)	221.6 (45.8) *	142.1 (36.3)	192.8 (58.5)	139.4 (33.6)	182.5 (23.6)
CHO	321.5 (56.2)	256.0 (58.5)	292.2 (49.6)	291.9 (108.5)	319.7 (99.1)	342.6 (86.4)	459.9 (104)*
Fat	115.9 (39.0)	90.3 (36.5)	168.3 (43.3) *	109.1 (33.8)	101.4 (39.7)	79.6 (25.1)	109.0 (32.6)
Energy intake	3070.1 (562.2)	2382.8 (552.5)	3569.5 (596) *	2717.9 (583)	2962.7 (676)	2644.7 (470)	3551.2 (596)

*p < 0.05 level of significance

The current study was the first of its kind in Ethiopian football nutrition, and aimed to measure the dietary intake, and record the sports nutrition and supplementation practices, of professional Ethiopian football players in seven Ethiopian Premier League clubs: three from the top, three from the bottom, and one club from the middle of the leader board. The findings of the current study show that there was significant difference between the seven clubs in the mean value of daily dietary proteins intake in grams, where ARMKFC players' intake was the highest, *M* = 221.6g/day, ±SD =

45.8 and HADYAFC players' intake was the lowest, *M* = 136.4g/day, ±SD = 40.6. Both clubs were from the bottom of the league table. As is shown in Table 4.2.8, the rest of the clubs fell within this range, proving that there is significantly more protein consumption among the Ethiopian Premier League football club players, especially the ARMK Football Club where players consume excessive amounts of dietary protein, probably due to the consumption of more animal protein, which in Ethiopia has associations with cultural practices (Oniang'o, 2003; Seleshe et al., 2014). Hence, players eat more protein than the recommended intake of 1.2 - 1.7g/kg of BW (Phillips & Van Loon, 2011). This imbalance may also be due to the absence of nutrition education programmes for the Ethiopian Premier League football players. Also, African food habits and cultural food preferences and taboos are often related to foods of animal origin, especially meat; the consumption of which also increases with income and urbanisation, possibly affecting players' dietary habits (García-Rovés, 2014; Oniang'o, 2003) Thus, an excessive intake of proteins beyond the recommended amount will replace CHOs, which should be the predominant fuel of players (Gibala, 2007). However, among the top three performers of the Ethiopian Premier League, SGFC. DDFC, and ADAFC, only DDFC players consume relatively smaller amounts of protein per day.

The results from the current study revealed that Ethiopian Premier League football players were consuming dietary CHOs below the daily recommendation for professional football players (500-600g/day) (Ruiz et al., 2005). Though it is well documented that CHO is a major macronutrient for fuelling professional football players, most studies have noted that daily CHO consumption of professional football players is usually lower than the recommended amount. Consequently, players' performance suffers hugely from a lack of sufficient fuel availability (García-Rovés, et al., 2014; Burke et al., 2006). However, in a similar study it was found that professional football players consume 526 g/day, which is better than the current Ethiopian football players (JesÚs Rico-Sanz et al., 1998). In the clubs involved in this study, it was found that only the top three Premier League football clubs during the study period consumed relatively higher amount of dietary CHO on a daily basis, SGFC, *M* = 459.9, ±SD = 104 grams, DDFC, *M* = 342.6, ±SD = 86.4 grams, and

ADAFC *M* = 319.7, ±SD = 99.1 grams respectively, compared with the bottom four clubs in the league table, HADYAFC *M* = 256.0, ±SD = 58.5 grams, CBEFC, *M* = 291.9, ±SD = 108.5 grams, ARMKFC*M* = 292.2, ±SD = 49.6 grams, and DASHEFC *M* = 321.5, ±SD = 56.2 grams. Of the seven study clubs, only players from the Saint George Football Club, which was league champion for many seasons, claimed daily dietary CHO intakes of 459.9 g/day, which closely matches the fuel needs of high intensity exercise (Burke et al., 2011). Though there is lack of literature on Ethiopian football nutrition, the peculiarity of the Saint George Football Club's higher CHO consumption compared to the rest of the Premier League clubs may be due to the club usually signing foreign coaches and players with greater experience and expertise, which as a result might have helped the club in accessing more knowledge of modern football ("Saint George S.C.," 2017, October 16).

Results from the current study revealed that the Ethiopian Premier League football club players consumed higher amounts of dietary fat (> 30%) (Table 4.2.6), at the expense of CHO intake, which would compromise their football performance. Through their dietary practices, football players should be aiming to provide their muscles with substrates to fuel the training sessions and to attain optimal recovery and performance boosts. However, the evidence available suggests that, given the highly aerobic nature of football, fat oxidation is more useful in facilitating recovery instead of providing a perfect fuel source for the players (García-Rovés, et al., 2014). The result shows that ARMKFC players, which are the worst performers in the league, consume significantly more dietary fat than the other clubs. This may be due to the lack of a professional nutritionist working with the club. In addition, the consumption of meat in Ethiopia is linked with traditional practices, especially in the southern part of the country where ARMKFC is based (Clark, 1999; Seleshe et al., 2014).

A low energy intake will not allow players to maintain a high level of training and competition, and the results of the current study revealed an inadequate energy intake on the part of the Ethiopian Premier League clubs, matching a similar study conducted in Puerto Rican Olympic team 20 years ago (JesÚs Rico-Sanz et al., 1998).

The mean daily energy demand for senior male football players has been estimated at 4000 kcal on training days and 3800 kcal on match days (Ruiz et al., 2005). Other studies have shown that football players consume 3952 kcal per day, of which 53 % of the intake is from CHO sources (JesÚs Rico-Sanz et al., 1998). By comparison, the energy intake of the Ethiopian Premier League football club players was low. Only two clubs had intakes approaching the level recommended (ARMKFC players: *M* = 3569.5, ±SD = 596 kcal per day and SGFC players: *M* = 3551.2, ±SD = 596 kcal per day). However, it needs to be highlighted that ARMKFC, which were the worst performers in the league, appeared to consume adequate energy, but lower dietary CHO, compared with SGFC players, who were the league champions. The largest source of energy for the ARMKFC players was dietary fat, which is not the preferred fuel for performance in football (Burke et al., 2011). The incorrect dietary intake of the ARMKFC players is perhaps because of the absence of a professional nutritionist in the club who could guide and educate players; as well as cultural factors (Seleshe et al., 2014; Heaney, 2011).

4.2.9. Percentage of Macronutrient intake across the seven clubs

Table 4.2.9 shows the mean percentages for macronutrient intake across the seven clubs currently playing in the Ethiopian Premier League. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc testing, to compare the macronutrient intakes. All three categories (percentage of dietary protein intake, percentage of dietary CHO intake, and percentage of dietary fat intake) were found to be significantly different, $p < 0.05$.

The mean value for the first category, that is percentage of dietary protein intake of ADAFC players *M* = 26.0, ±SD = 5.6, $p < 0.001$ was significantly different compared with all clubs (table 4.2.9.), particularly it was highly significant compared with SGFC *M* = 20.8, ±SD =2.6 players percentage of daily dietary protein intake. Whereas, The mean values in the second category, that is percentage of dietary CHO intake of both DDFC and SGFC*M* =51.8, ±SD = 8.2, $p < 0.001$, *M* = 51.6, ±SD = 6.1, $p < 0.001$ respectively were significantly different compared with all clubs daily

percentage of CHO intake, especially there was a highly significant difference with ARMKFC players daily percentage of CHO intake *M* = 33.4, ±SD = 7. 0. (table 4.2.9) displays the mean percentage values of dietary fat intake across the seven Ethiopian Premier League clubs; where uniquely, ARMKFC *M* = 41.8, ±SD = 6.3, p < 0.001 players consume a highly significant percentage amount of dietary fat compared with all clubs, especially with DDFC *M* = 27.1, ±SD = 7.1 and *M* = 27.5, ±SD = 6.0 players, respectively.

Table 4.2. 9. Mean (±SD) Percentages of macronutrient intake across clubs

	DASHFC	HADYAFC	ARMKFC	CBEFC	ADAF	DDFC	SGFC
Protein %	23.9 (4.3)	22.55 (2.9)	24.7 (2.0)	21,0 (3.5)	26.0 (5.6) *	21.1 (3.1)	20.8 (2.6) *
CHO%	42.7 (8.3) *	44.5 (11.0) *	33.4 (7.0) *	42.6 (10.5) *	43.7 (10.8) *	51.8 (8.2) *	51.6 (6.1) *
Fat%	33.4 (7.4) *	33.0 (9.0) *	41.8 (6.3) *	36.3 (8.7) *	30.4 (8.5) *	27.1 (7.1) *	27.5 (6.0)

*p < 0.05 level of significance

The results from the current study prove that Ethiopian Premier League football players consumed higher percentages of dietary protein per day, particularly the lower performing clubs, ARMKFC (24.7 %) and DASENFC (23.9 %). Even though the top two clubs consume relatively lower percentages of protein per day: DDFC (20.8 %) and SGFC (21.1 %), they still consumed percentages of protein (14.4% per day) that are similar to those found in a comparable study (JesÚs Rico-Sanz et al., 1998). The findings also suggest that Ethiopian professional football players consume more dietary proteins than the recommended amount of 12-15% of the total energy intake (Clark, 1994). This is may be because of the lack of nutrition education. In addition, socio-cultural traditions mean that people tend to eat more animal protein when their income increases, which is true for Ethiopian football players (Lokuruka, 2006; Oniang'o, 2003).

Football is characterised by intermittent, high-intensity movements, but the precise characteristics are unique from one game to the next. Regardless of the exact demands of each game, football performance is dependent on nutritional factors (Mujika & Burke, 2010). The results of the present study clearly demonstrated that there were significant differences in the daily dietary CHO intakes between the top and bottom clubs in the Ethiopian Premier League during the study period. The two top clubs, i.e. DDFC (51.8%) and SGFC (51.6 %), had a higher percentage of dietary CHO intake which, according to Clark, was closer to the minimum recommendation of 55 to 65 %. However, ARMKFC (33.4 %) and DASHENFC (42.7%) had lower daily dietary CHO intakes (Clark, 1994), which may negatively affect their performance. The reason for the lower dietary CHO intake for clubs in the bottom of the league table could be due to a lack of nutrition counselling for the players and staff, leading to higher protein consumption at the expense of dietary CHO (Clark, 1999).

It is important to note, from the results of the present study, that the Ethiopian Premier League football clubs' percentages of daily dietary fat intake could reflect their standing in the Premier League during the study period, where the top football clubs, DDFC (27.1%), SGFC (27.5%), and ADAFC (30.4%), consumed less than 30% of fat in their daily diets, which is the recommendation for football players (Clark, 1994). Though there may be several factors that determine football performance, this may contribute to their relatively better performance in the Ethiopian Premier League. By contrast, clubs at the bottom of the league table consume higher percentages of dietary fat, ranging from 33.0 % to 41.8 %, which is much higher than the recommended percentage. Hence, this may be one factor (among several) that accounts for why they are bottom of the league, as fat oxidation and the intensity of the current football game may not match up (Achten & Jeukendrup, 2003). The results of the current study also showed that the ARMKFC players consumed high amounts of dietary fat (41.8 %). This is most probably due to the cultural influences in the southern part of Ethiopia, where this particular club is located, which mean the population likes to eat more animal fat and meat (Oniang'o, 2003; Seleshe et al., 2014).

4.2.10. Macronutrient intake per kilogram of body weight across clubs

Table 4.2.10 shows the mean value for players' macronutrient intake per kilogram of body weight, across players at the seven clubs in the Ethiopian Premier League. A one-way analysis of variance (ANOVA) was conducted, followed by Bonferroni Post-hoc testing, to compare the players' macronutrient intakes, based on their body mass. All three categories, that is protein intake per kilogram of body weight, CHO intake per kilogram of body weight, and fat intake per kilogram of body weight, were significantly different $p < 0.05$.

The mean values for protein intake per kilogram of body weight of ARMKFC players $M = 3.0$, ±SD = .7, $p < 0.001$, were surprisingly highly significant compared with all clubs (table 4.2.10.) especially compared with HADYA players dietary protein intake per kilogram of body weight $M = 1.9$, ±SD = .6.Whereas, the mean values for CHO intake per kilogram of body weight of SGFC players $M = 6.1$, ±SD = 1.3, $p < 0.001$, was highly significant compared with all clubs (table 4.2.10), particularly with HADYA football club players $M = 3.6$, ±SD = .9. Likewise, the mean values for fat intake per kilogram of body weight of ARMKFC players $M = 2.3$, ±SD = .6, $p < 0.001$ was significantly different compared with all clubs, (table 4.2.10) particularly with DDFC players daily dietary fat intake per kilogram of body weight $M = 1.1$, ±SD = .3.

Table 4.2. 10. Mean (±SD) Macronutrient intake per kilogram of body weight across clubs

	DASHFC	HADYAFC	ARMKFC	CBEFC	ADAF	DDFC	SGFC
Protein	2.6 (.9)	1.9 (.6) *	3.0 (.7) *	2.0 (.5)	2.7 (.9)	2.0 (.5)	2.4 (.3)
CHO	4.5 (.9)	3.6 (.9) *	4.0 (.7)	4.1 (1.5)	4.5 (1.4)	4.8 (1.3)	6.1 (1.3)*
Fat	1.6 (.6)	1.3 (.5)	2.3 (.6) *	1.5 (.5)	1.4 (.6)	1.1 (.3) *	1.5 (.4)

*$p < 0.05$ level of significance

Results from the present study showed that professional football players from clubs at both the top and the bottom of the Ethiopian Premier League consumed more protein per kilogram of body weight, with ranges between 1.9 g/kg of BW/day (HADYAFC) to 3.0 g/kg of BW/day (ARMKFC), than the recommended amount of 1.5 to 1.8 /kg.BM/day (García-Rovés, et al., 2014). Moreover, ARMKFC players consumed exceptionally high amounts of protein per kilogram of body weight (3.0g/kg.BM). and it was noted that the remaining clubs consume similar amount ranging from 2.0 g/kg of BW/day to 26 g/kg of BW/day .The exceptional intake of ARMKFC could be a result of the food practices, values, attitudes, beliefs and cultural backgrounds of the players (Lokuruka, 2006; Oniang'o, 2003). Additionally, lack of nutrition education for football players may hinder their adoption of proper dietary practices (Murphy & Jeanes, 2006).

The results of the present study indicated that Ethiopian football players' dietary CHO intake is very low, ranging from 3.6 g/kg of BW/day to 6.1 g/kg of BW/day; even though the recommended amount is 6 - 10 g/kg of BW/day (Burke et al., 2011). But SGFC players, who were the champions during the study period, consumed the minimum recommended amount 6.1 g/kg of BW/day. Though it is not easy to find data on why SGFC meets this recommendation, the PI knows that the club can afford to sign foreign national coaches from Europe and players from other African countries; and the club could have benefited from their expertise, thus becoming more successful ("Saint George S.C.," 2017, October 16).

It is well documented that football players are advised to consume less than 30% of their daily dietary intake from dietary fat. It is not common to express daily dietary fat intake in terms of grams/kg of BW; instead it is quantified as percentage of daily fat consumption (García-Rovés, 2014). So the result of this study shows that players in the Ethiopian Premier League clubs consume more dietary fat than the recommended amount (Table 4.2.9.) (Clark, 1994; Williams, 1995). Particularly, the ARMKFC players' consumption of dietary fat is much higher than the rest of the clubs. This is most likely due to cultural

reasons, as the home of this football club is in a region known for its higher meat and fat consumption (Belay, Edwards, & Gebeyehu, 2005; Lokuruka, 2006).

4.2.11. Total macronutrient consumption of Ethiopian Premier League football club players

Table 4.2.11 shows the total macronutrient intake of the Ethiopian premier league professional football players, where dietary CHO intake was below recommended levels, and dietary protein and dietary fat were found to be higher than the recommendation.

Table 4.2. 11. Mean (±SD) Total macronutrient consumption of Ethiopian Premier League football club players

	In gram	**Per.kg.BM**	**percentage**
Protein	171.49 (52.6)	2.4 (.8)	22.9% (4.1)
CHO	326.3 (102.7)	4.5 (1.4)	44.3% (10.7)
Fat	110.5 (44.5)	1.5 (.6)	32.8% (9.9)

This table, showing the total macronutrient intake of the Ethiopian Premier League professional football players, clearly reveals that there was a disparity between the actual intake, and the ideal macronutrient consumption for professional football players, according to present nutrition knowledge. These inconsistencies may be due to the lack of scientific practices in the Ethiopian Premier League clubs, which critically need someone who can decide the overall sports nutrition philosophy at the club. (Collins, & Rollo, 2014)

4.3. Study 3. Training load, energy balance, performance and recovery of professional football players during a pre-season training macrocycle

Football is a team sport that necessitates continued, high-intensity, intermittent exercise (Rampinini et al., 2010). One of the main goals of the pre-season training phase in team sports is to develop fitness in preparation for the coming competition season. Compared with in-season, training loads (TL) which is the result of session –RPE that is the intensity (or how hard) of the training multiplied by duration of training session, are generally increased by two to four times during the pre-season period. Programming training during the pre-season can be challenging for coaches, since they are required to prescribe TLs that both maximise positive physiological adaptations, while avoiding overtraining and injury. Football players should ensure that they focus on their energy intake that will help them respond optimally to the pre-season load and recover quickly between training sessions and maintain their optimal body composition (Devlin, 2017). To monitor adaptation to training and recovery conducting sports specific testing on a regular basis is an important practice in professional football. Examining the relationships between training load, energy balance, and performance/recovery was a primary aim of this third study. The results of this study are summarised below.

4.3.1. Training load, intensity and macronutrient intake (in grams) of ADAFC players

Table 4.3.1 shows the mean values for the ADAFC players' daily TL and macronutrient intake in grams across the seven days (Monday to Sunday) of the pre-season training period. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc tests, to compare the players' daily TL and macronutrient intake in grams. All the macronutrient, except dietary CHO intake, were significantly different ($p < 0.05$). The mean values for players' Monday's TL, (M = 604, ±SD = 151 A.U. $p < 0.001$) was shown to be significantly different compared with Saturday's, TL (M = 240, ±SD = 55 AU)

However, Monday's TL was not significantly different compared with both Thursday's and Friday's TL

Table 4.3. 1. Mean (±SD) Training load and macronutrient intake in grams

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
TL	604 (151) *	393 (143) *	466 (84) *	510 (104)	549 (154)	240 (55)	423 (102)*
Protein	195 (21) *	213 (27) *	257 (44) *	186 (12) *	168 (24) *	211 (19) *	175 (17) *
CHO	373 (38)	507 (70)	333 (70)	341 (33)	378 (68)	339 (36)	352 (42)
Fat	156 (45)	165 (20)	179 (24) *	159 (28)	171 (26)	156 (27)	150 (26)*

*$p < 0.05$ level of significance

The aim of the current study was to quantify the pre-season daily training load of ADAFC players using s-RPE. The results of this study show that the ADAFC players' pre-season daily training load varied from day-to-day. The highest training load was measured on Monday with 604 AU (Arbitrary Unit), while the lowest was on Tuesday with 240 AU (Arbitrary Unit). It is believed that this variation will allow for players to recover and achieve better performances (Thorpe, 2017; Jaspers, 2017). This finding is consistent with current knowledge that a high level of monotony in training, with only slight variation in day-to-day training loads, may cause additional fatigue build-up (Watson, 2018; Pind, 2018). However, a lower monotony score would indicate good fluctuation in day-to-day loads, allowing for better recovery (Kiely, 2012). Other studies have shown that the variation in training load is influenced by the philosophy of the coach (Algrøy, 2011), and football coaches play a vital role in managing training monotony. Even though this study did not compare pre-season and in-season training loads, a decreased pre-season training load is inconsistent with the present knowledge, where training loads need to be greater during pre-season than in-season (Jeong, 2011; Ritchie, 2016).

The current study was the first of its kind in Ethiopian football nutrition and aimed to measure the effect of pre-season dietary practices on the performance and recovery of

ADAFC players. The findings of the current study show that players' daily dietary protein intake was higher than recommended guidelines (Boisseau, 2007; Phillips, 2012). However, there was a significant difference in daily dietary protein intake (grams) across the days of the week; where Wednesday's protein consumption was the highest and Friday's consumption was the lowest (Table 4.3.1). Dietary protein replaces CHO consumption, which should be the main source of fuel for football players (Ruiz, 2005). Similar studies have shown that protein and lipid intake of most football players exceeds recommended amounts (García-Rovés et al., 2014). While the traditional approach has been to ensure a high protein intake in the pre-season period, there is convincing evidence that an intake in excess of about 1.7 g/kg/day will not add further to protein synthesis for building or maintaining muscle mass or the repair damaged muscles (Maughan, & Shirreffs, 2007). Consumption of more animal protein, which in Ethiopia has associations with cultural practices may lead them to consume excess protein (Onoa,2012; Seleshe, 2014).

CHO are the major source of fuel in football. Similar studies have also shown that football players' diets are inappropriate with a high dietary fat consumption (Ruiz et al., 2005). However, the major issue of Ethiopian football players may be sociocultural influences, which cause them to deviate from professional and correct dietary practices (Oning'o, 2003) To mitigate these unprofessional dietary habits, players need to receive football-specific nutrition education to improve their performance and recovery time (Onoa, 2012)

4.3.2 ADAFC players' macronutrients intake per kilogram of body weight

Table 4.3.2 shows the mean values for ADAFC players' daily macronutrient intake per kilogram of body weight across seven days (Monday to Sunday), during the intense pre-season training period. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc tests, to compare the players' daily macronutrient intake

(Table 4.3.2). Only dietary protein intake per kilogram of body weight differed significantly $p < 0.05$.

The mean values for ADAFC players' dietary protein intake per kilogram of body weight on Mondays $M = 2.7$, ±SD = .3, $p < 0.001$ were found to be significantly different when compared with their Wednesday's dietary protein intake $M = 3.6$, ±SD = .7. The mean values for Tuesday's dietary protein intake per kilogram of body weight ($M = 2.9$, ±SD = .4, $p < 0.001$ were significantly different when compared with Wednesday's $M = 3.6$, ±SD = .7 and Friday's $M = 2.3$, ±SD = .4 dietary protein intakes per kilogram of body weight. Tuesday's dietary protein intake per kilogram of body weight, $M = 2.7$, ±SD = .3, $p = 0.002$ was significantly different to Sunday's; but there was no significant difference observed between their Thursday's and Saturday's dietary protein intakes. The mean values for Wednesday's dietary protein intake per kilogram of body weight, $M = 3.6$, ±SD = .7, $p < 0.001$ differed significantly compared with Thursday's $M = 2.6$, ±SD = .2, Friday's $M = 2.3$, ±SD = .4, Saturday's $M = 3.6$, ±SD = .7, and Sunday's $M = 2.4$, ±SD = .3 dietary protein intakes. The mean values for Friday's dietary protein intake per kilogram of body weight, $M = 2.3$, ±SD = .4, $p < 0.001$ was significantly different compared with Saturday's $M = 2.9$, ±SD = .3. Likewise, Saturday's dietary protein intake per kilogram of body weight $M = 2.9$, ±SD = .3, $p = 0.006$, was significantly different compared with Sunday's dietary protein intake per kilogram of body weight $M = 2.4$, ±SD = .3.

Table 4.3. 2. Mean (±SD) Macronutrient intake per kg of BW for ADAFC players

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Protein	2.7 (.3) *	2.9 (.4) *	3.6 (.7) *	2.6 (.2) *	2.3 (.4) *	2.9 (.3) *	2.4 (.3) *
CHO	5.1 (.7)	6.9 (.9)	4.6 (1)	4.7 (.6)	5.2 (1)	4.7 (.5)	4.8 (.7)
Fat	2.2 (.6)	2.3 (.3)	2.5 (4)	2.2 (.4)	2.4 (.4)	2.1 (.4)	2.1 (.4)

*p: < 0.05 level of significance

The results of the present study show that ADAFC players consumed very high amounts of dietary protein per kilogram of body weight during the pre-season week in the study period, with between 2.3 to 3.6 grams of protein per kilogram of body weight. This is contrary to the recommended 1.3 - 1.8 g/kg/BW per day (Phillips & Van Loon, 2011). Even though more protein should be consumed during pre-season periods, if the increased consumption of dietary protein leads to a smaller dietary CHO intake, this will affect players' performance negatively The higher dietary protein consumption of ADAFC players during the pre-season preparation time was the result of cultural influences which encouraged the consumption of animal protein, which is seen as a sign of affluence in Ethiopian people (Lokuruka, 2006; Seleshe et al., 2014). So, paying attention to players' football nutrition education and the provision of proper dietary advice by professionals will be key to alleviating the disparities in their diets (Clark, 1999 & Denna, 2018).

4.3.3 Percentages of macronutrient intake

Table 4.3.3 shows the mean values for ADAFC players' daily percentages of macronutrient intake across the seven days (Monday to Sunday) of the pre-season preparation period. A one-way analysis of variance (ANOVA) was conducted followed by Bonferroni Post-hoc tests, to compare the players' daily percentages of macronutrient intake. Percentages of dietary protein intake and percentages of dietary CHO intake were significantly different $p < 0.05$, but percentages of dietary fat intake were not statistically significant.

There was a significant difference in percentage of dietary protein intake across the seven days. This demonstrated that players were consuming varying number of dietary protein across the week. As a result, the mean values for Wednesday's percentages of dietary protein intake $M = 25.6$, $\pm SD = 3.7$, $p < 0.001$ was significantly different compared with all the days (table 4.3.2.), particularly it was highly significant when it was compared with Friday's percentage of dietary protein intake $M = 18.1$, $\pm SD = 1.4$. Likewise, there

was a significant difference in the percentage of dietary CHO intake across the seven days, which demonstrated that players were consuming varying number of dietary CHO throughout the week. Particularly, the mean values for players' percentages of dietary CHO intake on Monday M = 41.3, ±SD = 1.4, p = 0.001 was significantly different compared with all the days of the week, (table 4.3.2.), in particular there was a large difference compared with Wednesday's percentages of dietary CHO intake M = 33.5, ±SD = 4.9.

Table 4.3. 3. Mean (±SD) Percentages of macronutrient intake for ADAFC players

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Protein	21.4 (2.3) *	21.8 (4.9) *	25.6 (3.7) *	21.3 (2.2) *	18.1 (1.4) *	23.6 (2.1) *	20.3 (1.8) *
CHO	41.3 (7) *	39.8 (12) *	33.5 (4.9) *	38.6 (2.9) *	40.6 (3.9) *	37.8 (4.0) *	40.8 (4.2) *
Fat	37.2 (8.7)	38.3 (7.9)	40.5 (2.9)	40.1 (4.0)	41.3 (3.6)	38.7 (4.3)	38.8 (4.2)

*p: < 0.05 level of significance

The results of the present study show that players consume higher percentages of dietary protein during their pre-season preparation time, in the range of 18.1% to 25.6% of daily macronutrient consumption significantly higher than even the Ethiopian long-distance runners, consumption 12.4 ± 0.6% (Beis, 2011). The percentages of dietary protein intake of the players are not consistent with the current knowledge of acceptable macronutrient distribution range for endurance athletes, which is between 10% to 20% of daily consumption (Phillips, 2007). The fundamental macronutrient intake imbalances in the diets of the players, which were observed during this study, were due to deep-rooted cultural influences: relatively high-income communities which include football players prefer to consume injera, which is served with animal protein and stew in Ethiopia (Oniang'o, 2003; Seleshe et al., 2014). It is of paramount importance that a sports

nutritionist develop a strategy to implement proper dietary practices (Collins, & Rollo, 2014).

The results of the current study show that ADAFC players' daily percentages of CHO consumption over the week during the pre-season period were low (Table 4.3.2). The CHO intake (33.5 % to 41.3 %) was far lower than the Ethiopian long-distance runners' daily percentage of CHO intake (64.3 %) (Beis, 2011). Similarly lower than a reported intake (53.2%) in a similar study which was conducted 20 years ago (JesÚs Rico-Sanz et al., 1998). Research has shown that CHOs are the main source of fuel for training and match-play, and anything which compromises the optimal intake of CHOs will affect the performance of the players (Caruana Bonnici, 2018). Especially during the pre-season preparation period, players usually train hard with higher intensity, therefore the daily CHO availability should match the fuel needs of training and glycogen restoration (Burke et al., 2011; Rollo, 2014). Hence, the findings of this study are not consistent with the current knowledge that recommends a daily CHO intake of 55% to 80% of daily macronutrient intake for football players (Phillips, Moore, & Tang, , 2007).

The major cause of non-adherence to proper dietary practice by ADAFC players during the pre-season period may be that little or no attention was given to football nutrition practices. Other studies have similarly reported that limited attention is given to the nutritional intake of football players, with the focus primarily on tactical and technical aspects of the game (García-Rovés., 2014; Shattuck, 2001). As a result, proper dietary practice transformation through education will be paramount, if we expect good performances and quick recovery of football players, as there is a positive correlation between knowledge and dietary intake (Susan Heaney, 2011).

4.3.4. Yo-Yo Intermittent Recovery Test Results

Table 4.3.4 shows the results for the YOYOIRTL1 performance A paired-samples t-test was conducted to examine changes in the players' body weight before and after the week

of training. A paired-samples t-test was conducted to examine changes in the distance covered in the YOYOIRTL1 before and after the week of training. There was a statistically significant (t (19) = 6.6, p < .001) decrease in distance covered and measured from session 1 (*M* = 2266, ±SD=526 m) to session 2 (*M* = 1666, ±SD = 456 m). This result possibly indicates accumulated fatigue over the week of training. Likewise, a paired-samples t-test was conducted to examine the impact of the training on the time to fatigue in the YOYOIRTL1. There was a statistically significant decrease in the time to fatigue from session 1 (*M* = 18' 02", ±SD = 4' 01") to session 2 (*M* = 13' 06", ±SD = 3' 06" min), t (19) = 6.3, p < .001. A paired-samples t-test was also conducted to evaluate the impact of the week of training on predicted VO_2 max values based on the YOYOIRTL1 performance. There was a statistically significant (t (19) = 6.5, p < .001) decrease in predicted VO_2 max values from session 1 (*M* = 55.4, ±SD = 4.4 ml/min/kg) to session 2 (*M* = 50.4, ±SD = 3.8 ml/min/kg).

Table 4.3. 4. YOYOIRT1 Performance Pre-versus Post Seven Days of Pre-Season Training (N=20)

	Mean	SD	*P*<	Mean diff.	95% confidence interval	
					lower	upper
Pre-YOYO Distance (m) Post YOYO Distance (m)	2266 1666	526 455	0.001	600	409	791
Pre-YOYO Time (min) Post YOYO Time (min)	18' 02" 13' 06"	4.1 3.6	0.001	4.5	3.05	6.06
Pre VO_2max (ml/kg/min) Post VO_2max (ml/kg/min)	55.4 50.4	4.4 3.8	0.001	5	3.4	6.6

The results show that there was a significant 25% decrease in the distance covered, a 13% decrease in time to fatigue and a 10% decrease in the predicted VO_2 max from the first to second sessions of the YOYOIRT1 (Table 4.3.4). As the test is an effective measurement of fitness performance in football, the results reveal that there was less than optimal cardiovascular fitness of ADAFC players in response to this pre-season preparation week that suggested accumulated fatigue over the week (Krustrup, 2003; Bangsbo, 2006 ;Rampinini, 2010). In a similar study, no performance differences were found between the first and second sessions when the YOYOIRT1 was completed within seven days (Krustrup et al., 2003). However, another similar study, reported an 8% increase in the distance covered in the YOYOIRT1 (Serpiello, McKenna, Stepto, Bishop, & Aughey, 2011). The present study results suggested that the players had poor recovery protocols, possibly relating to nutritional practices, that were not helpful for replenishing depleted glycogen. These inadequate practices may result in accumulated fatigue and slow recovery that results in deficient performance of the test. The recovery mechanisms of players were not consistent with current recovery routines in football, which are used after physically intense competition or training to enhance, or at least maintain, performance in subsequent training and competition (Kinugasa, 2009b; Nedelec et al., 2013). Although there are no publications on the recovery strategies of Ethiopian football players, in general it is believed that players have very poor recovery procedures. This may due to the absence of conditioning and nutrition professionals who can assist and teach recovery strategies to lessen post-match or training fatigue (Milou Beelen, 2010).

4.3.5. Relationship between physiological qualities and Yo-Yo Intermittent Recovery Test level 1 (YO-YOIRT1) of ADAFC players

Table 4.3.5 shows the physical characteristics and energy balance of ADAFC players. There was a significant difference in energy balance of the players across the week (table 4.3.3.). This demonstrated that players EI and EE were varying across the week.

Table 4.3. 5. Mean (±SD) Anthropometric characteristics and energy balance of players

	Mean (SD)	Range
Age (years)	23.8(3.3)	18 - 30
Pre -Weight (kg)	73.2(6.1)	60 - 86
Post – Weight (kg)	72.5(6.4)	58 - 85
Height (cm)	180(0.06)	168 - 190
BMI (kg/m^2)	22.6(1.2)	19 - 24
Energy balance (joules)	-216.4(317.5)	-817 - 304

The results show that the mean age of the ADAFC players was similar to the age range at which professional football player's peak. A similar study found that professional football players peak between 25 and 27 years of age (Dendir, 2016). The results show that the body sizes of the players varied with the largest variation seen in body weight. Height ranged from 168 cm to 190 cm, which is typical for footballers, where different positions demand different physical characteristics (Deprez, 2015).

The correlations between energy balance and anthropometric characteristics of ADAFC players. were significant moderate, negative correlations between energy balance and age ($r = –.500$, $p = 0.025$), pre-weight ($r = -.474$, $p = 0.035$), and post-weight ($r = -.465$, $p = 0.039$) during the pre-season training week. But energy balance was not significantly correlated with height or BMI.

Research has reported that as a player's age increases, so their energy requirements decrease. Hence, the present finding is in agreement with the findings from earlier work (Roberts, 1998; Wilson, 2003). Due attention must be given to the players' ages to maintain the energy balance of the players, which is quite vital for performance in modern football.

The significant negative correlation between energy balance and body weight (M = -216.4, ±SD = 317.5) implies that the more negative the energy balance, the heavier the players will be. Heavier players were affected more than lighter players. It is well documented that players with increased body weight burn more calories than lighter players, as running economy is proportional to body weight (Saunders, 2004). This finding confirmed that dietary practice which is not individualised for each player will negatively affect heavier players. Nutrition should be calculated, based on per kilogram of body weight, so proper dietary strategies considering body weight are vital, instead of a 'one size fits all' approach.

The correlations between energy balance and the YOYOIRT1 performance was significant, moderate positive correlation between the energy balance and the pre-test performance distance covered (r = 0.462, p = 0.040), time to fatigue (r = 0.458, p = 0.042) and VO_2max (r = 0.466, p = 0.038). Increases in energy consumption were correlated with an increase in distance covered, in time to fatigue and maximal oxygen uptake. Similarly, there was also a significant moderate positive correlation between the energy balance and the post-test distance covered in metres (r = 0.456, p = 0.043), time to fatigue (r = 0.447, p = 0.048) and VO_2max (r = 0.458, p = 0.042). A decrease in energy consumption was correlated with a decrease in distance covered, in duration of exercise and in maximal oxygen uptake.

The findings suggested that appropriate energy consumption, or proper nutritional strategies, that can properly answer the physiological demands on the players should be implemented to enhance the football players' performance and recovery. Similar studies also confirm that it is vital to consider the energy demands of the game and be knowledgeable about the ideal substrate during training or games to get the most out of it (Bangsbo, Mohr, & Krustrup, 2006).

The findings from this study were not consistent with the current knowledge of recovery strategies which strive to improve, or at least preserve, performance in successive training sessions or matches (Kinugasa, 2009a). This can be the result unscientific training and

recovery mechanisms being implemented during the ADAFC players' pre-season period, and this may be due to the absence of an appropriate sport scientist working with the players, which is a common occurrence in Ethiopia. The findings of this study also revealed that there was a significant, moderately positive relationship between energy balance and players' maximal oxygen consumption, with decreased VO_2max values after seven days of pre-season training. The results were lower than those in a similar study conducted on non-elite Japanese college football players (VO_2max *M* = 59.5, ±SD = 2.5 ml/kg/min) and other elite football players (VO_2max *M* = 60.9, ±SD = 3.7 ml/kg/min) (Ueda, 2011). While there could be many other factors affecting the performance of ADAFC players, the negative energy balance values (*M* = -216.4, ±SD = 317.5) may play a possible role in affecting players' performance and recovery during the intense pre-season preparation period.

The results show that there was a moderately significant, positive correlation between the energy balance and the time to fatigue in the YOYOIRT1. Time to fatigue also decreased in the post-test. This was, of course, directly correlated with the distance covered during the test, so that the more distance the players covered, the longer the time to fatigue. These results suggest that the negative energy balance seen during the week of training may have influenced the YOYOIRT1 performance. Similar studies have shown that dietary supplementation improved the ability to undertake intense, intermittent exercise, as measured by the increased distance covered by the players and the longer time before exhaustion was experienced (McGregor, Nicholas, Lakomy, & Williams, 1999; Wylie et al., 2013).

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Study 1 - Conclusions

The aim of this study was to evaluate the impact of a sports nutrition education intervention on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period 2012-2014. The sport nutrition education intervention in this study positively impacted the players' understanding and knowledge of proper dietary practices, and hence improved their performance and recovery. The results of this study revealed that interest in nutrition education is high among football players in the Ethiopian national team. Most football players also seem to be very interested in learning more about practical sports nutrition in relation to performance and recovery (Ingram & Davies, 1996). Our results suggested that professional football players benefit from nutrition education. While this study was conducted on the Ethiopian national team players, further interventions and education on nutritional strategies for club and football academy players should be considered in conjunction with training and match play requirements in order to avoid injuries and to achieve optimal growth, development and performance.

5.1.1 Study 1 – Recommendations

After answering the critical questions of the study, the following recommendations are proposed:

- Nutrition education should be given as part of players' general training and preparation for the Ethiopian national team players, given that players had not previously received such education at national team or club level.
- Football clubs in the Ethiopian Premier League could take advantage of this enthusiasm and deliver sound dietary procedures through education to enhance the performance of their players.

- Management personnel of football clubs in the Ethiopian Premier League could attempt to secure funding to contract with dietitians and nutritionists to provide best-practice, current and relevant sport nutrition information to their players and staff.
- Football players' education needs to be entertaining instead of a student-teacher approach.
- The absence of football nutrition professionals needs to be addressed

5.2 Study 2 – Conclusions

The aim of the study was to measure the dietary intake, and record the sports nutrition and supplementation practices, of professional Ethiopian football players currently playing for Ethiopian Premier League clubs. The study revealed the nutritional ignorance of the Ethiopian football players at the seven clubs. CHO intake was replaced by high dietary protein and excessive fat consumption and fell short of minimum recommended guidelines; a cause for concern considering that CHOs are the main source of energy for footballers. This could explain why the players were in negative energy balance, resulting in an insufficient supply of energy for optimal performance in training and match-play. There is a universally inadequate nutrient intake among Ethiopian Premier League football players, which highlights the need for transformation in nutrition strategies at all the clubs. While acknowledging the discrepancies between the nutritional practices of the Ethiopian Premier League football players and the recommended guidelines, further research is needed to understand the true implications of such nutritional behaviour.

5.2.1 Study 2 – Recommendations

After answering the critical questions of the study, the following recommendations are proposed:

- The Ethiopian premier league football clubs should design and implement proper football nutrition practices through education programmes by designing curriculum to be used in breadth and depth of the nutrition education content to address this problem.

- Socio-cultural influences on the players' nutritional practices should be addressed to alleviate the problem.
- Football nutrition professionals need to be part of the coaching staff to closely advise the players and design their dietary intake.

  Football club managing bodies at the Ethiopian Premier League clubs need to understand about the importance of proper dietary practice, which is as important as the technical and tactical aspects of the game.

5.3 Study 3 – Conclusions

The aim of this study was to examine the effects of pre-season dietary practices on the performance and recovery of ADAFC players. Nutrition plays an important role in training adaptations, performance and sound recovery; along with the management of training and match loads, as well as other performance and recovery strategies. The dietary intake of ADAFC players was inadequate for their energy demands, and their CHO intake (which is the main source of fuel for football players) was below the recommended amount, CHO intake was not met due to increased proportion of protein intake due to the culture of meat consumption in Ethiopia, which suggests the need to improve nutritional practices to meet the physical demands of football during pre-season training. This study revealed that ADAFC players displayed a decrease in YOYOIRT1 performance after seven days of pre-season training. The YOYOIRT1 is a valid and reliable test to obtain information about a football player's capacity to perform repeated intense exercise and to examine changes in performance and fatigue. This study, therefore, provided further supporting evidence that ADAFC football players should consume a high-CHO diet to sustain performance and should implement recovery strategies to recover quickly from intense training. Future research might examine the design of a selection of optimal meal plans which will consider players' daily routines, positional play, and other practical socio-cultural concerns.

5.3.1 Study 3 – Recommendations

After answering the critical questions of the study, the following recommendations are proposed:

- ADAFC should design and implement proper pre-season football nutrition practices through education programmes to address the problem.
- Football clubs should consider signing professional fitness and conditioning professionals to address recovery issues.
- The influence of socio-cultural issues on proper dietary practices should be addressed by including nutrition education programmes as a daily training procedure.

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Appendices

Appendix-1 study permission letter

የኢትዮጵያ እግር ኳስ ፌዴሬሽን
ETHIOPIAN FOOTBALL FEDERATION

በ1935ዓ.ም ተመሠረተ FOUNDED IN 1943
የኢንተርናሽናል እግር ኳስ ፌዴሬሽን አባል 1935ዓ.ም
MEMBER OF FIFA - 1952
የአፍሪካ እግር ኳስ ኮንፌዴሬሽን አባል 1935ዓ.ም
MEMBER OF CAF - 1956

Ref. No. ቁጥር 21E.F.F/C.S/1165

Date ቀን Feb 3 - 2015

TO: UNIVERSITY OF KUAZULU.NATAL SCHOOL OF HEALTH SCIENCE DEPARTMENT OF BIOKIENTICS AND EXERCISE SCIENCE (SPORT SCIENCE)

SUBJECT: CONSENT LETTER

Student Tesfaye Berhane with student number of 214573066 who is by now a PhD candidate at your university UKZN, has requested the Ethiopian Football Federation to write a consent letter to the ethical committee of the university. And hence the EFF is willing and find it very important to be conducted. And we will let the researcher access to the document he may need for his research work and conduct his experiment, with his preferred title **Diet and supplementation practice in professional Ethiopian football players: Effects on performance and recovery.** Which will be addressed as three part study?

1. Evaluative case study on the dietary practice of the professional Ethiopian football players: a case of the Ethiopian national team from 2012 to 2014.
2. Dietary intake assessments of the Ethiopian premier league football player.
3. Dietary carbohydrate supplementation to professional football players in Ethiopia.

And finally the Ethiopian Football Federation appreciates UKZN and wish the researcher all the best during his study hoping that the result will advance our football development.

Best Regards,

ZERIHUN BIADGILIGN ALMAW
GENERAL SECRETARY

ዓለም አቀፍ ደረጃ ያለው እግር ኳስ በሀገራችን እንዲኖር እንጥራለን !!
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☎ +251-11-558 52 41, 515 62 05, 558 52 73, 515 62 67, 🖷+251-11-551-58 99 - E-mail:eff1@ethionet.et
✉ 1080 - አዲስ አበባ ኢትዮጵያ Addis Ababa, Ethiopia

Appendix-2 Consent Form for PhD study 1

Evaluation of the impact of a sports nutrition education programme on the dietary, sports nutrition and supplement practices of the Ethiopian national football squad during the period of 2012 to 2014.

Principal Investigator:	Tesfaye Berhane Maasho
Institution:	University of KwaZulu-Natal
Sponsor:	Ethiopian Ministry of Education and UKZN**.**

This Informed Consent Form has two parts:

- Information Sheet (to share information about the research with you)
- Certificate of Consent (for signatures if you agree to take part)

PART I: Information Sheet

Dear Potential Research Participant,

This serves as an invitation to you to participate in a PhD research study examining sports nutrition in football.

My name is Tesfaye Berhane, a PhD candidate at the University of KwaZulu-Natal, South Africa. I am conducting a study examining the effects of the nutrition programme that I implemented for the Ethiopian National Football Squad from the period of 2012 to 2014. Specifically, I would like to talk to you about your experiences and the effect that the nutrition programme had on you.

You do not have to decide today if you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain.

Purpose of the research

Football is one of the most widely played games in Ethiopia both recreationally and professionally. The diets that are currently used to help professional players are not as good as we would like them to be. The reason we are doing this research is to get insight from experienced football players and coaches regarding the effects of the nutrition education programme.

Type of Research Intervention

This research will involve only interviewing and group discussion about your experience during the period of 2012-2014. Information will be obtained regarding your nutrition and supplementation practice, hydration strategy, recovery strategy, your nutrition class, your knowledge about macronutrients, micronutrients, fruits and vegetables will also be topics of our discussion.

Participant selection

You are selected for this research because you were member of the national squad as a player and coaching staff during the period of 2012-2014.

Confidentiality

This research project is unique in Ethiopia. It is possible that if others in the community are aware that you are participating, they may ask you questions. We will not be sharing the identity of those participating in the research.

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one, but the researchers will be able to see it. Any information about you will be number coded ad your name will not be used. Only the researchers will know what your number/name is, and this information will be kept in a secured location. It will not be shared with or given to anyone except the Principal investigator and his supervisor.

Sharing the Results

The knowledge that we get from doing this research will be shared with you through club meetings before it is made widely available to the public. Individual, confidential information will not be shared and only the overall findings will be discussed.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all your rights will still be respected.

Contact details

PI:	Tesfaye Berhane Maasho
Email:	rationalism2002@gmail.com
Mobil:	+251911370089
Supervisor:	Associate Professor Andrew McKune
Email:	Andrew.McKune@canberra.edu.au
Co supervisor:	Associate Professor Johan van Heerden
Email:	vanheerdenj@ukzn.ac.za

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

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University of KwaZulu-Natal

Private Bag X 54001, Durban, 4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2602486 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant_____

Signature of Participant _____

Date _____

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____, AND thumb print of participant

Signature of witness _____

Date _____

Statement by the PI/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of PI/person taking the consent_____

Signature of PI /person taking the consent_____

Date_____

Amharic version

የጥናትና ምርምር ተሳትፎ ስምምነት ቅጽ (ለፒ ኤች ዲ ጥናት አንድ)

የጥናቱ መሪ ----------ተስፋዬ ብርሃኔ ማሾ

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ይህ ቅጽ ሁለት ክፍሎች አሉት

1. የመረጃ ቅጽ

2. የተሳትፎ ማረጋገጫ ቅጽ

ክፍል አንድ - የመረጃ ቅጽ

መግቢያ

እኔ ተስፋዬ ብርሃኔ በደቡብ አፍሪካ ኩዋዙሉ ናታል ዩኒቨርሲቲ ዕጩ የፒ ኢች ዲ ተማሪ ስሆን የማከሂደውም ጥናት በኢትዮጵያ የሙሉ ጊዜ እግር ኳስ ተጫዋቾች አመጋገብ ስርአትንና መጠንን ነው፡፡ ይህም ጥናት በሀገሪቱ ከዚህ ቀደም ያልተዳሰሰ ጉዳይ ነው፡፡ በመሆኑም እርስዎን የዚህ ጥናት አካል እንዲሆኑ ስጋብዝ በአክብሮት ሲሆን የጥናቱ አካል ለመሆን ወይንም ላለመሆን በማንኛውም ጊዜ እና ሰዓት የመወሰን መብትዎ የተጠበቀ ነው፡፡ በተጨማሪም ሊብራራልዎት ወይን ግልፅ ያልሆነልዎን ጉዳይ ሲጋጥምዎ የጥናቱን መሪ እንዲብራራልዎት መጠየቅ ይችላሉ፡፡

የጥናቱ ጠቀሜታ

የዚህ ጥናት ጠቀሜታ የኢትዮጵያ ብሄራዊ ቡድን ከ2012 እሰከ 2014 ዓ/ም ድረስ ባደረጋቸው የዓለም ዋንጫና የአፍሪካ ዋንጫ ማጣሪያዎች የአሰመዘገበውን ውጤት ከተደረገለት የአመጋገብ ሥርዓት ለውጥ አንጻር ወደኋላ መለስ ብሎ የነበሩትን ሁኔታዎች ለመዳሰስና ከዚህም ለከለቦችና ለቀጣይም ብሄራዊ ቡድን ተሞክሮዎችን መቀመር ነው፡፡

አብይ የጥናት ክንውኖች

የዚህ ጥናት ዋና ክንውን በብሄራዊ ቡድኑ የተደረገውን የአመጋገብ ስርዓት ለውጥ ተመልሶ መዳሰስ ነው፡፡

የተሳታፊ አመራረጥ

የዚህ ጥናት ተሳታፊዎች ከ2012 እሰከ 2014 ዓ/ም ባለው ጊዜ ውስጥ ተመርጠው ለኢትዮጵያ ብሄራዊ ቡድን ተመርጠው የተጫወቱ ስፖርተኞች እና ኮቺንግ እስታፍ መሆን አለባቸው፡፡

ሚስጥራዊነት

ምንም እንኳን በጥያቄና መልስ ሂደት በሀገራችን ጥናቶች ማድረግ የተለመደ ቢሆንም የዚህ ጥናት ተሳታፊዎች የሚያደረጉዋቸው መጠይቆችና ውይይቶች ከሚመለከታቸው የጥናቱ አከላት በስተቀር ሚስጥራዊነታቸው በአስተማማኝ ሁኔታ የተጠበቀ ነው፡፡

የጥናቱ ውጤት ተጠቃሚዎች

በዚህ የጥናትና ምርምር ውጤት እርሶና አሀን ያሉበት ክለብ ከጥናቱ ውጤት ተጋሪ እንደሚሆኑ ከወዲሁ እናረጋግጣለን፡፡

ከጥናቱ ራስን የማግለል መብት

በጥናቱ ሂደት በማንኛውም ሰዓትና ጊዜ ራስዎን ከተሳትፎ የማግለል ሙሉ መብትዎ የተጠበቀ ነው፡፡

ክፍል ሁለት - የተሳትፎ ማረጋገጫ ቅጽ

የምስክር ወረቀት

ከላይ በቅጽ አንድ በዝርዝር የተቀመጡትን ጭብጦች አንብቤ ጠይቄና ተገንዝቤ ያወኩ በመሆኑ በዚህ ጥናትና ምርምር ውስጥ ተሳታፊ ለመሆን ያለምንም አስገዳጅነትና ተጽዕኖ ለመሳተፍ ወስኛለሁ፡፡

የተሳታፊ ስም_____

ፊርማ _____

ቀን_____

ማንበብና መጻፍ ለማይችሉ

በቅፅ አንድ የተዘረዘሩትን መስፈርቶች ለተሳታፊው በትክክልና በሚገባ መልኩ ቀርቦለት የተረዳውና ተሳታፊ ለመሆን አረጋግጦልኛል ፡፡

የእማኝ ስም _____

ፊርማ_____

ቀን_____

የተሳታፊ ስም_____

አሻራ

ቀን_____

የጥናት መሪው መግለጫ

ከላይ በቅጽ አንድና ሁለት የተዘረዘሩትን መስፈርቶች በትክክልና በአግባቡ በማስረዳት ተሳታፊዎች ንዲረዱት አድርጊለሁ፡፡ በወቅቱም ተሳታፊዎቹ ግልጽ ያልሆኑላቸውንና ያልተረዱትን ጉዳይ በማብራራት ተሳታፊዎቹ ያለምንም ተጽዕኖ በነጻነት የትናቱ አካል እነደሚሆንለኝ አረጋግጠዋል፡፡ ለዚህም ለእንዳንዱ ተሳታፊ የቅጹ ግልበጭ እንዲደርሳቸው አድርጊያለሁ፡፡

የጥናቱ መሪ ስም_____

ፊርማ_____

ቀን _____

Appendix-3 Informed consent form for PhD study 2 (ICF)

The dietary intake, sports nutrition and supplementation practices of professional Ethiopian football players in current Ethiopian Premier League clubs.

English version.

Principal investigator:	Tesfaye Berhane Maasho
Institution:	University of Kwazulu- Natal
Sponsor:	Ethiopian Ministry of education and UKZN

This Informed Consent Form has two parts:

- Information Sheet (to share information about the research with you)

Certificate of Consent (for signatures if you agree to take part).

PART I: Information Sheet

Dear Potential Research Participant,

This serves as an invitation to you to participate in a PhD research study examining sports nutrition in football.

My name is Tesfaye Berhane, a PhD candidate at the University of KwaZulu-Natal, South Africa. I am conducting a study examining the dietary intake and sport nutrition and supplementation practices of professional football players in Ethiopia.

You do not have to decide today if you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain.

Purpose of the research

Football is one of the most widely played game in Ethiopia both recreationally and professionally. There is limited information available on the dietary intake and sports nutrition and supplementation practices of professional Ethiopian football players. Such information is important to help the performance, health and recovery of football players.

Type of Research Intervention

This research will involve the weighing and recording of your food intake and drink with digital scale for one week only. And this will involve an investigator weighing every item of food and drink prior to consumption. A detailed description of the food and its weight is recorded in a specially designed booklet and usually a space is left to record any leftovers so that the precise weight of food eaten can be calculated and the PI will assure you that all this process will be done without disturbing your mood to eat and drink.

Participant selection

You are selected for this research based on your club's table standing.

Risks

There are no physical, psychological or financial risks associated with this study.

Confidentiality

This research project is unique in Ethiopia. It is possible that if others in the community are aware that you are participating, they may ask you questions. We will not be sharing the identity of those participating in the research.

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one, but the researchers will be able to see it. Any information about you will be number coded ad your name will not be used. Only the researchers will know what your number/name is, and this information will be kept in a secured location. It will not be shared with or given to anyone except the Principal investigator and his supervisor.

Sharing the Results

The knowledge that we get from doing this research will be shared with you through club meetings before it is made widely available to the public. Individual, confidential information will not be shared and only the overall findings will be discussed.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all your rights will still be respected.

Contact details

PI:	Tesfaye Berhane Maasho
Email:	rationalism2002@gmail.com
Mobil:	+251911370089
Supervisor:	Associate Professor Andrew McKune
Email:	Andrew.McKune@canberra.edu.au
Co supervisor:	Associate Professor Johan van Heerden
Email**:**	vanheerdenj@ukzn.ac.za

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

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University of KwaZulu-Natal

Private Bag X 54001, Durban, 4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2602486 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant_____

Signature of Participant _____

Date _____

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

*Print name of witness*_____ *AND, thumb print of participant*

Signature of witness _____

Date _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of PI/person taking the consent: _____

Signature of PI /person taking the consent: _____

Date: _____

Amharic version

የጥናትና ምርምር ተሳትፎ ስምምነት ቅጽ (ለፒ ኤች ዲ ጥናት ሁለት)

የጥናቱ መሪ ----------ተስፋዬ ብርሃኔ ማሾ

የትምህርት ተቋም ---------- ኩዋዙሉ ናታል ዩኒቨርሲቲ

የጥናቱ ደጋፊ አካለት ----------ት/ሚ እና ኩዋዙሉ ናታል ዩኒቨርሲቲ

ይህ ቅጽ ሁለት ክፍሎች አሉት

1. የመረጃ ቅጽ

2. የተሳትፎ ማረጋገጫ ቅጽ

ክፍል አንድ - የመረጃ ቅጽ

መግቢያ

እኔ ተስፋዬ ብርሃኔ በደቡብ አፍሪካ ኩዋዙሉ ናታል ዩኒቨርሲቲ ዕጩ የፒ ኢች ዲ ተማሪ ስሆን የማከሂደውም ጥናት በኢትዮጵያ የሙሉ ጊዚ እግር ኳስ ተጫዋቾች አመጋገብ ስርአትንና መጠንን ነው፡፡ ይህም ጥናት በሀገሪቱ ከዚህ ቀደም ያልተዳሰሰ ጉዳይ ነው፡፡ በመሆኑም እርስዎን የዚህ ጥናት አካል እንዲሆኑ ስጋብዝ በአክብሮት ሲሆን የጥናቱ አካል ለመሆን ወይንም ላለመሆን በማንኛውም ጊዜ እና ሰዓት የመወሰን መብትዎ የተጠበቀ ነው፡፡ በተጨማሪም ሊብራራልዎት ወይን ግልፅ ያልሆነልዎን ጉዳይ ሲጋጥምዎ የጥናቱን መሪ እንዲብራራልዎት መጠየቅ ይችላሉ፡፡

የጥናቱ ጠቀሜታ

ምንም እንኳን የእግር ኳስ ስፖርት በኢትዮጵያ በብዙዎቹ ዘንድ ተዘውታሪ ቢሆንም ለስፖርቱ የሚመጥን የአመጋገብ ስርዓት ባለመኖሩ የዚህ ጥናት አስፈላጊነት በእጅጉ የጎላ ነው፡፡

አብይ የጥናት ክንውኖች

በዚህ ጥናት ውስጥ ስፖርተኛው ሚመገበው የምግብ መጠን ልኬት የስራው ማጠንጠኛ ማዕከል ነው፡፡

የተሳታፊ አመራረጥ

የዚህ ጥናት ተሣታፊ የሆኑት ከለብዎ ባለው የደረጃ ሠንጠረዥ የተነሳ ሲሆን ጥናቱ ሙሉ በመሉ ከጉዳት የጸዳ ነው፡
፡

ሚስጥራዊነት

ምንም እንኳን በዚህ ጥናት ውስጥ ከማህበረሰቡ ወጣ ያለ አሠራር ቢሆንም የዚህን የጥናት ክንውንና ሂደት ሚስጥራዊነት የምንጠብቅ መሆኑን ስንገልጽ የጥናቱ መሪና የሚመለከታቸው አካላት ብቻ እንዲያዩት ይደረጋል፡፡

የጥናቱ ውጤት ተጠቃሚዎች

በዚህ የጥናትና ምርምር ውጤት እርሶና ከለብዎ ተጠቃሚ እንድምትሆኑ እንገልጻለን፡፡

ከጥናቱ ራስን የማግለል መብት

በጥናቱ ሂደት በማንኛውም ሰዓትና ጊዜ ራስዎን ከተሳትፎ የማግለል ሙሉ መብትዎ የተጠበቀ ነው፡፡

ክፍል ሁለት - የተሳትፎ ማረጋገጫ ቅጽ

የምስክር ወረቀት

ከላይ በቅጽ አንድ በዝርዝር የተቀመጡትን ጭብጦች አንብቤ ጠይቄና ተገንዝቤ ያወኩ በመሆኑ በዚህ ጥናትና ምርምር ውስጥ ተሳታፊ ለመሆን ያለምንም አስገዳጅነትና ተጽዕኖ ለመሳተፍ ወስኛለሁ::

የተሳታፊ ስም_____

ፊርማ _____

ቀን_____

ማንበብና መጻፍ ለማይችሉ

በቅፅ አንድ የተዘረዘሩትን መስፈርቶች ለተሳታፊው በትክክልና በሚገባ መልኩ ቀርቦለት የተረዳውና ተሳታፊ ለመሆን አረጋግጦልኛል

የእማኝ ስም _____

ፊርማ_____

ቀን_____

የተሳታፊ ስም_____

አሻራ

ቀን_____

የጥናት መሪው መግለጫ

ከላይ በቅጽ አንድና ሁለት የተዘረዘሩትን መስፈርቶች በትክክልና በአግባቡ በማስረዳት ተሳታፊዎች ንዲረዱት አድርጊለሁ፡፡ በወቅቱም ተሳታፊዎቹ ግልጽ ያልሆኑላቸውንና ያልተረዱትን ጉዳይ በማብራራት ተሳታፊዎቹ ያለምንም ተጽዕኖ በነጻነት የትናቱ አካል እነደሚሆንለኝ አረጋግጠዋል፡፡ ለዚህም ለእንዳንዱ ተሳታፊ የቅጹ ግልበጭ እንዲደርሳቸው አድርጊያለሁ፡፡

የጥናቱ መሪ ስም_____

ፊርማ_____

ቀን _____

Appendix-4 Informed consent form for PhD study 3 (ICF)

The effects of a CHO supplement intervention on the performance and recovery of Ethiopian professional football players

English version

Investigator:	Tesfaye Berhane Maasho
Institution:	University of KwaZulu-Natal
Sponsor:	Ethiopian Ministry of education and UKZN

This Informed Consent Form has two parts:

- Information Sheet (to share information about the research with you)
- Certificate of Consent (for signatures if you agree to take part)

PART I: Information Sheet

Dear Potential Research Participant,

This serves as an invitation to you to participate in a PhD research study examining sports nutrition in football.

My name is Tesfaye Berhane, a PhD candidate at the University of KwaZulu-Natal, South Africa. I am conducting a study examining the effects of CHO supplementation on professional football players in Ethiopia.

You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain.

Purpose of the research

Football is one of the most widely played games in Ethiopia both recreationally and professionally. This will be the first study in Ethiopia to examine the effects of CHO supplementation before and after practice on performance and recovery of professional Ethiopian football players.

Research Intervention

The trial will take place over a four-week period during the pre-season training of your club. And you will receive either a CHO or placebo solution that is 4% or 40 grams of CHO solution in 1000ml of water per hour which is a low osmolality solution that will not cause gastrointestinal discomfort to you. The placebo solution will be artificial

sweetener which is zero calorie that are not able to provide physiological benefit to improve your performance.

In addition, you will be requested to perform the Yoyo intermittent recovery test once in a week during the month. From this the PI will be able to get how much distance you cover during the test to assess your performance and recovery time. The other most important test will be session RPE which will be conducted 30 minutes after every training session for one month. You will be expected to state how strenuous your workout was which can be used to monitor your training load. You are also requested to complete a recovery questionnaire everyday over the month to get an idea about your physiological and psychological state of rest and recovery. Mechanical and metabolic stress placed on your skeletal muscle fibers due to training might cause muscle soreness that we will monitor everyday using a muscle soreness scale. Finally, your performance and recovery can be affected by many stressors including those at home. You will therefore also be required to complete the DALD questionnaire daily over the month that monitors training and life stressors.

Participant selection

The inclusion criteria to participate in the study will be: 1) only players who are registered to play during the study season, 2) players who have been medically cleared by the team Sports Medicine Physician to participate and who are not injured or ill.

Risks

This study might have some injury risks, like soft tissue injuries especially the Yo-yo intermittent recovery test 1 and vertical jump tests. Therefore, the PI will make sure to minimize the risks by conducting the study with proper professional coaches. You will only be allowed to perform the tests after a proper warm up and if you are free from injury and illness. But you have also all legal ground to seek insurance which may occur during this study.

Confidentiality

This research project is unique in Ethiopia. It is possible that if others in the community are aware that you are participating, they may ask you questions. We will not be sharing the identity of those participating in the research.

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one, but the researchers will be able to see it. Any information about you will be number coded ad your name will not be used. Only the researchers will know what your number/name is, and this information will be kept in a secured location. It will not be shared with or given to anyone except the Principal investigator and his supervisor.

Sharing the Results

The knowledge that we get from doing this research will be shared with you through club meetings before it is made widely available to the public. Individual, confidential information will not be shared and only the overall findings will be discussed.

Right to Refuse or Withdraw.

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all your rights will still be respected.

Contact details

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Email:	Andrew.McKune@canberra.edu.au
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Email:	vanheerdenj@ukzn.ac.za

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Tel: 27 31 2602486 - Fax: 27 31 2604609

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PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant_____

Signature of Participant _____

Date _____

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____ AND Thumb print of participant

Signature of witness _____

Date _____

Statement by the researcher

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of researcher taking the consent: _____

Signature of researcher taking the consent: _____

Date: _____

Amharic version

የጥናትና ምርምር ተሳትፎ ስምምነት ቅጽ (ለፒ ኤች ዲ ጥናት ሥሥት)

የጥናቱ መሪ ----------ተስፋዬ ብርሃኔ ማሾ

የትምህርት ተቋም ---------- ኩዋዙሉ ናታል ዩኒቨርሲቲ

የጥናቱ ደጋፊ አካለት ----------ት/ሚ እና ኩዋዙሉ ናታል ዩኒቨርሲቲ

ይህ ቅጽ ሁለት ክፍሎች አሉት

1. የመረጃ ቅጽ
2. የተሳትፎ ማረጋገጫ ቅጽ

ክፍል አንድ - የመረጃ ቅጽ

መግቢያ

እኔ ተስፋዬ ብርሃኔ በደቡብ አፍሪካ ኩዋዙሉ ናታል ዩኒቨርሲቲ ዕጩ የፒ ኢች ዲ ተማሪ ስሆን የማከሂደውም ጥናት በኢትዮጵያ የሙሉ ጊዚ እግር ኳስ ተጫዋቾች አመጋገብ ስርአትንና መጠንን ነው፡፡ ይህም ጥናት በሀገሪቱ ከዚህ ቀደም ያልተዳሰሰ ጉዳይ ነው፡፡ በመሆኑም እርስዎን የዚህ ጥናት አካል እንዲሆኑ ስጋብዝ በአክብሮት ሲሆን የጥናቱ አካል ለመሆን ወይንም ላለመሆን በማንኛውም ጊዜ እና ሰዓት የመወሰን መብትዎ የተጠበቀ ነው፡፡ በተጨማሪም ሊብራራልዎት ወይን ግልፅ ያልሆነልዎን ጉዳይ ሲጋጥምዎ የጥናቱን መሪ እንዲብራራልዎት መጠየቅ ይችላሉ፡፡

የጥናቱ ጠቀሜታ

ምንም እንኳን የእግር ኳስ ስፖርት በኢትዮጵያ በብዙዎቹ ዘንድ ተዘውታሪ ቢሆንም ለስፖርቱ የሚመጥን የአመጋገብ ስርዓት ባለመኖሩ የዚህ ጥናት አስፈላጊነት በእጅጉ የጎላ ነው፡፡

አብይ የጥናት ክንውኖች

በዚህ ጥናት ውስጥ ለስፖርተኛው በጨዋታና በልምምድ ወቅት ተጨማሪ ኃይል ሰጪ ፈሳሽ በመስጠት በጨዋታ እና በልምምድ ወቅት ያላቸውን አቅምና ማገገሚያ ጊዜ የሚያመጣውን ተጽዕኖ ማጥናት ነው፡፡

የተሳታፊ አመራረጥ

የዚህ ጥናት ተሣታፊ ሆነው ለመመረጥ የበቁት ክለብዎ የዚህን ጥናት ግብና ዓላማ ለመደገፍ ባላቸው ቀና ፍላጎት የተነሳ ነው፡፡

ሚስጥራዊነት

ምንም እንኳን በዚህ ጥናት ውስጥ ከማህበረሰቡ ወጣ ያለ አሠራር ቢሆንም የዚህን የጥናት ክንውንና ሂደት ሚስጥራዊነት የምንጠብቅ መሆኑን ስንገልጽ የጥናቱ መሪና የሚመለከታቸው አካላት ብቻ እንዲያዩት ይደረጋል፡፡

የጥናቱ ውጤት ተጠቃሚዎች

የዚህ ጥናትና ምርምር ውጤት ከእርሶና ክለብዎ ባሻገር የሀገራችንን እግር ኳስ ስፖርት ተጠቃሚ እንዲሆኑ ያስችላል፡

፡

ከጥናቱ ራስን የማግለል መብት

በጥናቱ ሂደት በማንኛውም ሰዓትና ጊዜ ራስዎን ከተሳትፎ የማግለል ሙሉ መብትዎ የተጠበቀ ነው፡፡

ክፍል ሁለት - የተሳትፎ ማረጋገጫ ቅጽ

የምስክር ወረቀት

ከላይ በቅጽ አንድ በዝርዝር የተቀመጡትን ጭብጦች አንብቤ ጠይቄና ተገንዝቤ ያወኩ በመሆኑ በዚህ ጥናትና ምርምር ውስጥ ተሳታፊ ለመሆን ያለምንም አስገዳጅነትና ተጽዕኖ ለመሳተፍ ወስኛለሁ፡፡

የተሳታፊ ስም_____

ፊርማ _____

ቀን_____

ማንበብና መጻፍ ለማይችሉ

በቅፅ አንድ የተዘረዘሩትን መስፈርቶች ለተሳታፊው በትክክልና በሚገባ መልኩ ቀርቦለት የተረዳውና ተሳታፊ ለመሆን አረጋግጠልኛል

የእማኝ ስም _____

ፊርማ_____

ቀን_____

የተሳታፊ ስም_____

አሻራ

ቀን_____

የጥናት መሪው መግለጫ

ከላይ በቅጽ አንድና ሁለት የተዘረዘሩትን መስፈርቶች በትክክልና በአግባቡ በማስረዳት ተሳታፊዎች ንዲረዱት አድርጊለሁ፡፡ በወቅቱም ተሳታፊዎቹ ግልጽ ያልሆኑላቸውንና ያልተረዱትን ጉዳይ በማብራራት ተሳታፊዎቹ ያለምንምተጽዕኖ በነጻነት የትናቱ አካል እነደሚሆንለኝ አረጋግጠዋል፡፡ ለዚህም ለእንዳንዱ ተሳታፊ የቅጹ ግልበጭ እንዲደርሳቸው አድርጊያለሁ፡፡

የጥናቱ መሪ ስም_____

ፊርማ_____

ቀን _____

Appendix-5 Interview and focus group questionnaire for national team players.

Participant code: **_____**

Age: **_____**

Club: **_____**

Education: **_____**

The following interview and focus group questionnaire are developed by the PI and will be piloted on the new Ethiopian national team squad for their reliability and validity.

Part one for players only.

1. Please tell me about your diet and supplementation culture at your club? What was your club during that time? Do you have a professional person in charge of your diet?

2. Please explain me about the diet and supplementation practices of team Ethiopia during your stay. On the following points:

- ✓ Before your practice or match
- ✓ During your practice or match
- ✓ After your practice or match
- ✓ Your recovery mechanism
- ✓ Your Hydration techniques

3. What was your feeling experience always after your practice?

4. Please tell me if you had illness or injury during your stay with the team? If you had did you recover soon or not?

5. Please explain me about your nutrition and recovery education? How was it to you?

6. Please explain me about the following:

- ✓ CHO
- ✓ Protein
- ✓ Fat
- ✓ Sports drink
- ✓ Fruits and vegetables
- ✓ alcohol

7. Did you usually loss or gain weight while you re-join your club after your stay in the national team?

Part two for coaching staff only

Participant code: **_____**

Age: **_____**

Club coaching or working: **_____**

Education: **_____**

1. Once you were the Ethiopian national team coach. What was the difference between that team and the team which were during the period 2012- 2014 regarding their nutritional and supplementation practices?

2. You were working as the physiotherapist of team Ethiopia for the last 25 years. Can you explain me the occurrences of injury, and compare me the nutritional and supplementation practices of those players and those who were between 2012- 2014?

3. Do you believe player's education matters a lot regarding their dietary practices and recovery strategy? If yes how?

4. What is the role of diet and supplementation practice in today's modern football?

ለኢትዮጵያ ብሔራዊ ቡደን ተጫዋቾችና አሠልጣኞች የተዘጋጀ ቃለ - መጠይቅ

ሥም_____ ዕድሜ _____ የት/ት ደረጃ_____

የሚጫወትበት ክለብ_____

መጀመርያ ለዚህ ቃለ መጠይቅ/ ውይይት በመገኘትዎ የአክብሮት ምስጋናዬን አቀርባለሁ፡፡ የሚኖረን መልካም ቆይታ እርሶ ወይንም እናንተ ከ2012 – 2014 ዓ/ም በብሔራዊ ቡድን በነበራቸሁ ቆይታ ስለነበረው የአመጋገብ ሥርዓትና ተያይዞም ሲሰጣቸሁ ስለነበረው ትምህርት የሚያጠነጥን ነው፡፡

ለተጫዋቾች የተዘጋጀ ቃለ - መጠይቅ

1. በወቅቱ ስለነበራቸሁበት ክለብ አመጋገብ ባህል እስኪ ንገሩኝ? የስፖርት ስነ ምግብ ባለሙያ ነበራቸሁ?
2. በብሔራዊ ቡድን በነበራችሁበት ጊዜ በሚከተሉት ነጥቦች በመነሳት እስኪ ስለአመጋገብ ሥርዓታቸሁ አብራሩልኝ፡፡

- ከጨዋታ በፊት
- በጨዋታ ጊዜ
- ከጨዋታ በኋላ
- እንዴት ነበር የምታገግሙት
- እንዴት ነበር ፈሳሽ የምትጠቀሙት

3. ከጨዋታ ወይንም ከልምምድ በኋላ ስሜታቸሁ እንዴት ነበር?
4. በቆይታቸሁ ጉዳት ወይንም ህመም ኢጋጥሟቸሁ ያውቃል ለማገገምስ የወሰደባቸሁ ጊዜ?
5. እስኪ በወቅቱ ይሰጣችሁ ስለነበረው ትምህርት ሁኔታ አብራሩልኝ:
6. አሁን ደግሞ በሚከተሉት ነጥቦች ላይ ያላቸሁን ግንዛቤ አብራሩልኝ፡፡

- ስለኃይል ሰጪ ምግቦች
- ስለገንቢ ምግቦች
- ስለቅባት ያላቸው ምግቦች
- ስለስፖርት ፈሳሽ
- ስለአትክልትና ፍራፍሬ
- ስለ አልኮል

7. ወደ ክለባቸሁ ስትመለሱ ክብደት ትጨምራላቸሁ ወይንስ ትቀንሳላቸሁ?

አመሰግናለሁ!

ለአሠልጣኖች የተዘጋጀ ቃለ - መጠይቅ

ሥም_____ **ዕድሜ** _____ **የት/ት ደረጃ**_____

የሚያሰለጥንበት ወይንም የሚሰራበት ክለብ_____

1. ከዚህ በፊት የኢትዮጵያ ብሔራዊ ቡድን አሠልጣኝ ነበሩ ከቀድሞው ቡድን እና አሁን በቅርቡ ከያዙት ቡድን በአመጋገብ ሥርዓት አኳያ ያለውን ልዩነት ያብራሩለኝ

2. ላለፉት 25 ዓመታትና ከዚያም በላይ ለኢትዮጵያ ብሔራዊ ቡድን በወጌሻነት ሰርተዋል፡፡ የተጫዋች የጉዳት ክስተት በእግር ኳስ ስፖርት ያለ ቢሆንም በቅርቡ ከነበረው ቡድን ጋር ከአመጋገብ ስርዓቱና ከማገገሚያ ሥርዓታችን አንጻር እያወዳደሩ ቢነግሩኝ፡፡

3. ለተጫዋች ስለምግብ ስርዓትና ስለበቂ እረፍት ማስተማር ተጽዕኖ አለው ብለው ያምናሉ? እንዴት?

4. ዘመናዊ እግር ኳስ እና ትክክለኛ የስፖርት አመጋገብ ያለው ሚና ምንድን ነው?

አመሰግናለሁ!

Appendix-6 Session RPE questions

Participant code: _____
Date: _____

How was your workout?

Modified rating perceived exertion scale used for athletes to classify their perceived intensity of each training session.

- 0 Rest
- 1 Very, Very easy
- 2 Easy
- 3 Moderate
- 4 Somewhat hard
- 5 Hard
- 6
- 7 Very hard
- 8
- 9
- 10 Maximal

Appendix 7 Ethics certificate

TRREE

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Certificado
Certificate

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