Sport Sciences for Health (2022) 18:171–178
https://doi.org/10.1007/s11332-021-00790-3

ORIGINAL ARTICLE

Dietary practices of soccer athletes registered at the University of Limpopo, Limpopo Province, South Africa

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Received: 12 June 2020 / Accepted: 24 May 2021 / Published online: 4 June 2021

Abstract

Background There is a growing number of athletes participating in soccer sports within the higher institutions of learning. However, studies involving the dietary practices of these athletes remain relatively scarce.

Objective To determine the dietary practices of soccer athletes registered at the University of Limpopo, Limpopo Province, South Africa.

Methodology This was a descriptive quantitative study, which adopted a purposive sampling technique to obtain 31 out of 40 registered soccer athletes representing the University of Limpopo as a team. The approval was obtained from the Turfloop Research and Ethics Committee (TREC). Data were collected at the University of Limpopo sports grounds, in the afternoons before the commencement of the training. The demographic status which included the gender, weight, and duration of athletes involved in sports of soccer at the University were collected. The weights of the athletes were also measured using a digital scale from SECA to calculate the nutrient requirements. The dietary practices of athletes were collected using the modified 24-h recall questionnaire on three different days. Athletes were required to recall all food items consumed in the previous 24 h. The researchers used household measuring utensils and food models to assist athletes in estimating food quantities. Athletes were required to recall incidences that took place in the previous to associate with food items taken. Food Frequency Questionnaire was used to determine the regularity of consumption of different food items. The nutrient intake for the athletes was obtained from the average analysis of the three 24-h recall questionnaires through MRC Food Finder (version 3.0). The SPSS software (24.0) was then used to determine descriptive tests expressing variables as percentages, means, standard deviations ($\pm$SD), and minimum and maximum values. The obtained test results were then compared to the recommendations by the International Society of Sports Nutrition (2018).

Results Majority (81.0%) of athletes engaged in soccer sport for $\leq$2 years while at University. Overall, 61% of athletes consumed three meals/day. Only 65% consumed meals 2–3 h before the training. Majority of the athletes ($\geq$61%) consumed carbohydrates, protein, and fat below the International Society of Sports Nutrition (ISSN) recommendations. Additionally, more than 65% of the same athletes consumed vitamins and minerals below the recommendations. None of the athletes consumed any food immediately after training.

Conclusion The dietary intakes were below the ISSN recommendations. The dietary practices of athletes involved in the sport of soccer at the University of Limpopo were not adhering to soccer nutritional guidelines. Therefore, athletes need to receive nutrition support through the appointment of nutrition experts or dietitians to assist in nutrition and dietary related practices of athletes. Involvement of other multidisciplinary members is also warranted in sports of soccer and other sports categories to improve athletes' performance without compromising their health.

Keywords Nutrients · Soccer · Athletes · Recommendations

Introduction

Athletes registered within the sport of soccer depend on each other's performance for success. Their performance may, however, be affected by a multiplicity of factors including nutrition [1]. Athletes need to involve nutrition practitioners

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due to varying dietary needs [2]. This step will assist athletes in making healthier dietary choices as they are frequently misled around dietary topics in sports [3]. Proper nutrition provides athletes with support for health and performance [4] and the foundation necessary to recover from exercise strain. Nutrients requirements for athletes generally depend on the intensity of that training program [2]. Meaning, a more intense training program would require additional nutrients. The sport of soccer involves intense training regimens which in turn, require a proper dietary plan to adhere to. For instance, during the duration of a soccer match, the heart rate is maintained at 85% of maximal oxygen uptake (VO_{2max}) [4]. There is a growing number of athletes participating in soccer sport across the world [4]; however, studies among black Africans remain relatively scarce. This sport is also notable as the most participated amongst other sports, such as cricket, rugby and netball activities at the University of Limpopo (UL), South Africa. The UL attracts mostly black African students from the rural areas of Limpopo and Mpumalanga Provinces; from whom, a university soccer team is composed. However, the dietary practices of these University soccer team athletes remain unknown. The dietary practices of a team need to adhere to standards in minimising disadvantages during sports performance, and undesired health outcomes during the active academic years; and even later in life. The current researchers intend to contribute positively towards improvements in soccer sport ratings and dietary knowledge among fellow black athletes. This study will form the basis on which scholars can adopt and/or modify methods to be used in larger studies. Furthermore, this study is aiming to ignite passion and interest in soccer concerning nutrition and athletic performance.

Athletes require a properly planned diet that provides adequate energy and nutrients to support training and prevent deficiencies [2]. Adequate energy to maintain body weight, while optimizing performance is required [5]. Intakes that are too restrictive may compromise training or performance [6], resulting from the loss of muscle mass, fatigue, poor bone density, and menstrual dysfunction (in female athletes) [5]. Additionally, athletes adhering to energy-restricted diets may experience poor coordination, increased irritability, and dehydration [2]. Therefore, energy requirements for soccer athletes can be achieved through a diet offering approximately 105–147 kJ (25–35 kcal)/kg/day [7]. To reach this energy requirement, athletes should spread the nutrient intake throughout the day [2] by consuming 4–6 meals including snacks [8].

Energy-restricted diets may greatly affect the quantity of macronutrients required, for instance, carbohydrates (CHO). CHO is the main energy contributor during the sports performance offering up to 70% of total energy [4]. This macronutrient serves as a main source of fuel for the brain, central nervous system, and muscles during the training sessions. CHO is a quick glucose provider, yielding more energy to sustain training [9]. Athletes involved in endurance training sessions, such as soccer, may require amounts ranging from 6 to 8 g/kg/day to support their training needs [4]. Other researchers recommend 6–10 g/kg/day for athletes involved in high-intensity training [10]. A slightly higher amount of CHO ranging from 8 to 10 g/kg/day is recommended to support the training needs of this sport [11]. This recommendation is somewhat similar to those made by and the ISSN (2018) of 8 to 10 g/kg/day for high-intensity sports [7]. Timing of food to improve performance is encouraged for the athletes [2]. A pre-training meal containing 1–4 g/kg of digestible CHO [12] is encouraged 3–4 h before the soccer training/match to promote adequate liver glycogen stores [4]. High glycemic index CHO is recommended to facilitate quicker glucose supply; although there are concerns around insulin fluctuations [13]. CHO that are low in the glycemic index may delay digestive processes resulting in gastrointestinal discomfort, such as bloating, nausea, and vomiting [12, 14]. However, in instances where adequate time before the training might be a challenge, CHO amounts of 1–2 g/kg consumed 1–2 h before the training session are recommended [13]. To achieve favorable results during soccer match performance, athletes are encouraged to ingest a CHO solution with electrolytes combined [1]. The solution should contain a dextrose amount of 6–8%, ingested every 15–20 min as part of fluids [7]. To replenish muscle glycogen stores, a CHO amount of 1 g/kg for up to 4 h is recommended [4]. Immediately after the soccer training, a CHO amount of 1.2 g/kg is recommended within the first 30 min [1, 12], while an additional 1.5 g/kg should be consumed in the next 3 h post-training to improve immune function and glycogen resynthesis [12].

Consumption of adequate energy and CHO during sports performance is important for protein-sparing effects [5]. Protein is necessary for maintaining normal physiological functions during athletic sports performance and support post-exercise recovery [6]. Emphasis should be on high-quality biological value proteins of 1.6–2.2 g/kg/day that are spread throughout the day [4]. These amounts are based on the increased protein oxidation athletes often experience during sports performance [5]. Therefore, to meeting protein recommendations, smaller frequent meals scheduled at 3–4 h interval offering 20–25 g of protein are recommended [4]. Pre-training meal containing 0.25–0.4 g/kg of protein, taken at least 1–4 h before physical activity is recommended to support the training [15]. Furthermore, to repair damaged muscles, athletes need to consume 0.25–0.3 g/kg [12] or 20 g of high-quality protein combined with CHO immediately after exercise/performance. On a whole, protein amounts of 1.4–2 g/kg/day are considered sufficient for soccer athletes to maintain muscle regeneration and withstand post-training stress [7].

Fat is another macronutrient that serves as the source of fuel for the athlete's performance [1]. This macronutrient further serves as a provider for essential fatty acids and aids in the absorption of fat-soluble vitamins [4]. Fat recommendation for athletes is quite similar to that made for the population, 0.5–1 g/kg/day (≤ 30% of total energy) [7]. Intakes of up to 35% TE are further recommended to obtain adequate omega-3 and omega-6 fatty acids [4], and further replenish the intramuscular triacylglycerol storage [7]. Higher intakes above this range are not supported [5] as associated with ill health [10], while severe restrictions are associated with essential fatty acids deficiencies [12]. Therefore, athletes may require adequate nutrition education around food sources of fats to assist them in making better choices [7].

Adequate hydration is another determining factor for athletic success [5]. Fluid deficit and dehydration are common among athletes involved in soccer sports, resulting from a decline in plasma volume and increased muscle contraction during exercise [12]. These changes usually drop the plasma volume thus overloading the cardiovascular system [4] and a rise in body temperature [16]. Therefore, athletes should not rely on thirst sensation for hydration but aim for adequate hydration before the soccer match [4]. Athletes should keep hydrated through distributed intakes of 150–200 mL every 15–20 min [17]. During hydration of athletes, fluids used should contain CHO and electrolytes combined [4]. When monitoring fluids through the body weight, loses of up to 2% of pre-training body weight as fluids may be acceptable. However, more than 2% loss may greatly affect exercise performance [12]. Therefore, intake between 5 and 10 mL/kg of fluid [18], at least 2–4 h before exercise and 0.4–0.8 L/h of 4–8% drinks during exercise [16] are recommended to minimise the risk of dehydration.

Athletes participating in sport, particularly those representing the University teams, may generally require nutritional guidance as this group may frequently skip meals, snacks, and have financial barriers or lack time as challenges to good nutrition practices. Disordered eating habits are also a common problem for these University athletes. It is a concern that the dietary practices of soccer athletes in Limpopo remain unknown. These soccer athletes may be vulnerable to nutritional risks due to an increase in demands in their sport [6]. The risk is further doubled by nutrition information sources that may at times mislead them towards unhealthy food choices or practices [14]. Therefore, the researchers aimed at determining the dietary practices of these athletes with a focus on University soccer team to minimize nutritional risks, for the athletes to enjoy their lifelong sports careers.

Methods

A descriptive, purposive method of study was undertaken to recruit 31 out of 40 students' soccer athletes registered at the University of Limpopo. The university is situated in Limpopo Province, ± 30 km way from Polokwane city, Capricorn district; South Africa. A purposive sampling technique was used given the limited number of students registering for the University soccer team. Only those students who were registered in the University as students, willing, and gave consent to participate were included in the study.

Ethics approval

Ethical clearance was obtained from the Turfloop Research Ethics Committee (TREC) and permission was received from the sports ground manager of the University and coaches. Consent to participate in the study was sought from the soccer athletes. Procedures undertaken during the process were under a full understanding by and the written consent of, the participants.

Data collection

Data were collected at the Oscar Mpetha stadium of the University of Limpopo in the afternoons between 16H00–17H00, an hour before the start of training. The demography, which included but not limited to age, gender, nutrition information sources, such as coaches, nutrition experts, or media platforms used and the duration which athletes had been involved in sports of soccer, while at the University were collected using a self-designed questionnaire. The weights of the athletes were also measured using a digital weighing scale (Model 813, SECA Inc., Hamburg, Germany) with a capacity of up to 200 kg. In collecting the weight, the scale was calibrated and zeroed before measurements were taken. Athletes were in their minimal clothing and barefooted when measuring the weights. Thereafter, athletes were requested to stand upright on a measuring scale with the weight spread evenly on both legs. Measurements of weight were recorded to the nearest 0.1 kg [19]. The measurement of weight was necessary to calculate the nutrient requirements of each athlete. A modified 24-h recall and Food Frequency questionnaires (FFQ) adapted from the National Food Consumption Survey (1999) were used to determine in detail, the food items consumed the previous day and the frequency thereof, respectively. The questionnaire included periods in which the meals were consumed and quantities. Multiple 24-h recalls were collected on three different days, two during weekdays (Wednesdays and Friday) and the other over the weekend (Monday) to evaluate

the eating pattern. Athletes were assisted in remembering all food items consumed in the previous 24 h and estimating portion sizes through probing and the use of food model mannequins, respectively. Questions about activities in which athletes participated in the previous day to assist in recalling details of food eaten at or before that time were also asked. The modified FFQ was then used to determine the frequency of consumption of each particular food item. The FFQ was completed on the third day of the last 24-h recall data collection. The questionnaires, 24-h recall, and the FFQ were modified to include the timing of meals for the athletes and considering the most commonly consumed food among soccer athletes in the University of Limpopo, respectively. The majority of these food items were found to be those items that are generally consumed around the province.

Data analysis

Data for 31 out of 40 soccer athletes were analysed, giving a response rate of 78%. Data were analysed using the SPSS version 23 and descriptive variables were expressed in mean values and standard deviations (± SD). The mean, minimum and maximum values of weights for the athletes were determined. Data from the multiple 24-h recalls were loaded in the Food Finder version 3 to determine the analysis of nutrient intakes. The average macronutrient and micronutrient intakes of the athletes were then compared to the ISSN (2018) and the Food and Nutrition Board of the Institute of Medicine (FNBIM) [12] recommendations as presented in Tables 1 and 2, respectively. Intakes are reported as either below, within, or above recommendations.

Results

All the athletes registered in the soccer sport were males, a majority (83.8%) of whom aged between 21 and 25 years, followed by 18–20 years (9.7%) and 26–30 years (6.5%). The mean weight (kg) for athletes was 66.37(± 4.73) with the minimum and maximum values of 55 and 76 kg, respectively (Table 3). Ninety percent (90%) of the athletes consumed 2–3 meals per day. About 65% of the athletes consumed meals 2–3 h before engaging in a training session, 50% of whom were involved in the University soccer team for a year but have been participating as soccer team members for a while at their respective communities. The overall dietary intakes of the athletes are summarised in Table 4. Percentages of nutrient intake are presented in Figs. 1 and 2. Internet (55%) and coaches (32%) served as nutrition information sources for the athletes other than sports nutrition experts/dietitians (13%) (Figs. 3, 4, 5).

Table 1 Macronutrient recommendation [10]

Macronutrient	Recommendation/kg/day	Distribution (TE) (%)
Energy	105–147 kJ	
Protein	1.4–2 g	15–20
Carbohydrates	8–10 g	55–65
Fat	0.5–1 g	25–30

TE total energy

Table 3 Summary of weight values for athletes

Analyte	Mean (± SD)	Min.	Max.
Weight (kg)	66.37 (± 4.731)	55	76

The table above illustrates the weight range of the athletes. The minimum and maximum weights were 55 and 76 kg, respectively

Table 2 Micronutrient recommendation [12]

Vitamin	RDA (mg/day)	UL (mg/day[a])
C	90	1200–2000
D	15 µg[b]	100 µg
E	15 mg	1000 mg
Minerals	RDA (mg/day)	UL (mg/day)
Ca	1000	1200–1300
Mg	2.3	240–320
Fe	8–15	15–18

[a]Milligram

[b]Microgram

Table 4 Summary of macronutrient intake by athletes

Analyte	Mean (±SD)	Min.	Max.	Percentage inadequate ($n=31$)
Energy (kJ)	5994.6 (±2040.2)	2423	10,519	45.1
Protein (g)	49.6 (±21.1)	14.8	96.3	61.3
CHO (g)	224.7 (±80.0)	68.4	427.8	100
Fat (g)	27.7 (±0.0)	3.9	75.08	61.2

The table above illustrates that all athletes (100%) consumed CHO below recommendations, while more than 60% had inadequate intake of protein and fat

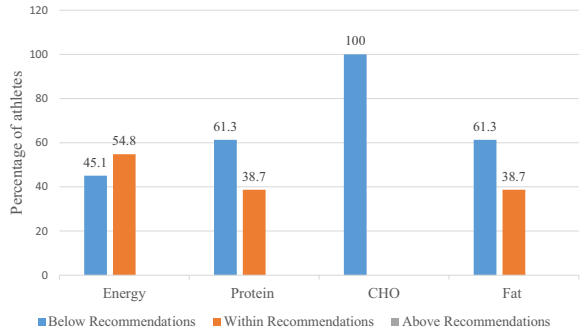

Fig. 1 Illustrates macronutrients intake by athletes. Majority of athletes (61.3 and 61.3%) consumed protein and fat below recommendations. All athletes (100%) consumed CHO below recommendations. More than half (54.8%) of athletes consumed energy within recommendations

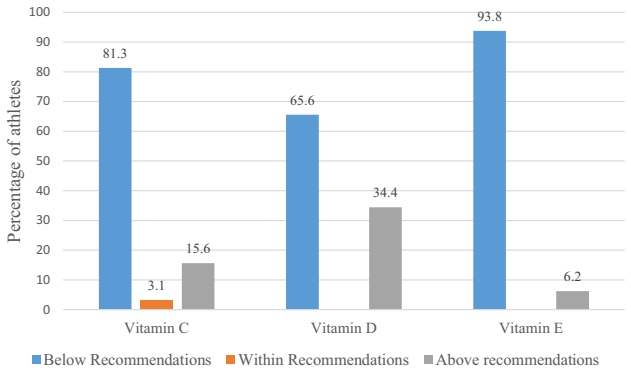

Fig. 2 Illustrates the vitamin intake of athletes. Majority of the athletes (93.8, 81.3 and 65.6%) consumed vitamins E, C, and D below the recommendations in that order. Only 34.4 and 6.2% consumed vitamins D and E above the recommendations, respectively

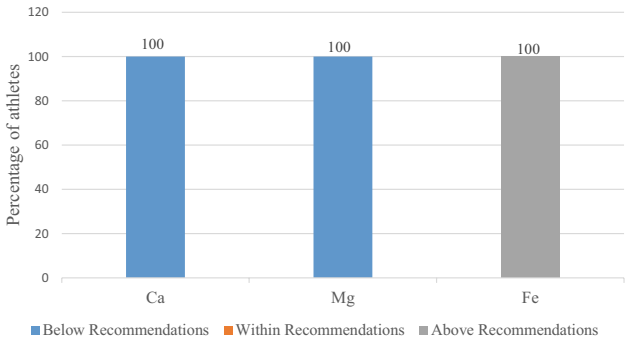

Fig. 3 Illustrates the percentage of mineral distribution for the athletes. All the athletes (100%) consumed calcium, magnesium, and iron below the EAR

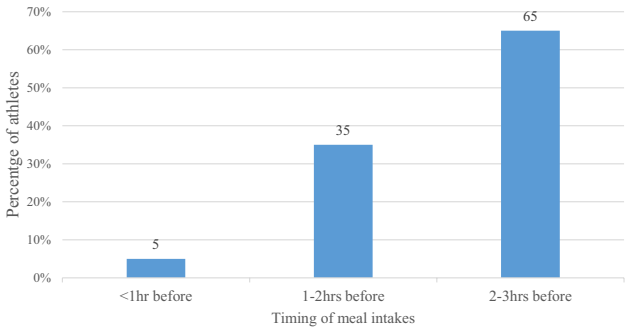

Fig. 4 Illustrates the timing of meal intakes before the training. The majority of athletes (65%) consumed meals 2–3 h before the training

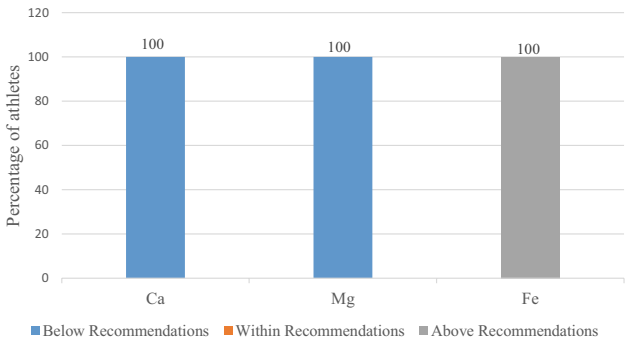

Fig. 5 Illustrates the nutrition information sources used by athletes. The majority of athletes (55%) were using the internet as their nutrition information source. Athletes using nutrition experts were relatively few (13%)

Discussion

In the current study, the intake of all macronutrients was below the recommendations. In sports, literature generally reports inadequate energy-dense foods amongst male athletes compared to females [20]. Diets that are too restrictive of certain macronutrients, for instance, fats are associated with essential fatty acids and fat-soluble deficiencies and imbalances in the lipoprotein profile [12]. Similarly, athletes consuming low CHO diets are prone

to diminished performance due to low muscle glycogen storage [1]. Although Kerksick et al. reported energy deficits from analysis of athletes' diets [7]; it is very doubtful though that, in our study intakes of all macronutrients, especially that of CHO will fall below recommendations. This is because starchy foods, such as maize, for instance, are a common staple food around Limpopo Province. We, therefore, postulate that athletes in our study may have selected or under-reported their intakes in an attempt to impress interviewers given our profession. Under-reporting is common when using a 24-h recall questionnaire as the tool relies strictly on memory.

On the other hand, endurance sports, such as soccer, may drive athletes to control their weight through energy deficits or low-calorie diets [1]. In our group, almost all athletes (90%) consumed 2–3 meals per day. This may further explain the reason for the inadequate intake of macronutrients. Athletes need to consume adequate amounts of macronutrients to optimize sports performance [7]. Adequate energy and macronutrients can be attained through the intake of 4–6 meals per day, with snacks for athletes to offset energy deficits [1, 8].

The majority of the athletes consumed specific vitamins (C, D, and E) below the recommendations. This may result from insufficiencies established in energy and macronutrient consumption by athletes. Wallinga concurs with the latter statement [6]. Reduced intake of dietary fats may adversely affect the amount consumed, absorption, and metabolism of fat-soluble vitamins, such as vitamin D and E in this case [12]. Both fat and oils appeared least on the athletes' dietary information, which may explain inadequate levels in our case.

Intake of specific minerals (calcium and magnesium) was below recommendations in all our athletes. Minerals that are below recommendations may be derived from diets that are deficient in energy [6]. This might be true as in our study, as most athletes consumed CHO and energy below recommendations for their sport. Insufficient vitamin and mineral levels diminish the chances of training oxidative damage and reduced exercise/training capacity [8].

The majority of athletes in our study consumed meals 2–3 h before engaging in training sessions. This is a recommended practice [7, 8] as consumption, especially that of CHO increases muscle glycogen stores by up to 15% [1]. Soccer athletes in our study did not consume any food item or a solution during their training sessions, except for water. Water has been a common means of rehydration used by athletes; however, limited intakes of CHO during training or performance sessions can greatly affect liver and muscle glycogen storage, resulting in poor performance [1]. Immediately (30 min) after training, athletes in our group had no meal/food intake. This practice is contrary to recommendations of 1.2 g/day made by Williams and Rollo [1] to replenish muscle glycogen stores. This amount of CHO and other foods high in fluids can be attained through the assistance of sports nutrition practitioners [2]. Other than pre-training meal intake, general meal frequency throughout the day remains a challenge for our athlete's group. Athletes consumed 2–3 meals per day instead of smaller frequent meals of 4–6 meals. Smaller frequent meals spread throughout the day replenish glycogen stores, prevent risks of nutrient deficiencies and assist athletes in maintaining their desirable weights [2, 8].

More than two-thirds of the athletes in our study relied on the internet and coaches as their source of nutrition information. Manore et al. reported similar findings, where nutrition information sources for the young athletes were investigated [21]. Although their study focused on high school young athletes, coaches/family members and media were the main sources in their group. Additional to the latter, Mitchell et al. similarly report the internet as the most used form of nutrition information source (55%) among bodybuilding athletes [22]. In another study by Hornstrom et al., athletic trainers were stated second from physicians as a source of nutrition information by the softball collegiate athletics [14]. These sources may have not received formal nutrition training or have limited nutrition information [14] predisposing athletes to nutritional deficiencies soon or later in life. Athletes should be guided on making proper nutrition choices that will assist in guiding their practices towards healthier choices thus preventing nutrition deficiencies and enjoying their lifelong careers [6]. Manore et al. highlighted that access to nutrition experts for instance; dietitian may be a challenge for most athletes [21]. However, in our context, student soccer athletes were students at the university, where sports dietitians are available for support.

Conclusion and recommendation

This study aimed to determine the dietary practices of soccer athletes at the University of Limpopo soccer team. The nutrients intake of these athletes was below sports recommendations. Not all the practices of nutrient dosing during and immediately after training were appropriately practiced. Overall, the dietary practices of these athletes were not in line with the recommendations of the sports of soccer. These athletes were involved in soccer training or match sessions while overlooking their nutritional component. This may predispose them to nutritional deficiencies and later health hitches, such as bone problems whenever continuing in this sport. Therefore, the involvement of dietetic/nutrition

practitioners within existing team members, such as coaches and trainers, may assist this group in nutrition guidance for instance; diet plans, body composition, and weight monitoring [23]. The researchers are aware that the findings of this study cannot be generalized given the smaller sample size. However, it creates a platform for larger studies to be conducted within the same group of athletes and other related sports to assist athletes to adopt healthy eating habits while enjoying their diverse sports.

Acknowledgements The University of Limpopo sports center and coaches for granting the opportunity for the study to be undertaken. We would like to acknowledge soccer athletes of the University of Limpopo for participating in the study.

Author contributions MTM, MPM, and SCS conducted the study; MTM, MPM, SCS, and SM analysed the results and SM wrote the manuscript. All authors contributed to the final preparation of the manuscript.

Funding The authors declare that there is no source of funding for this study.

Declarations

Conflict of interest The authors declare that there is no conflict of interest for this study.

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