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SOUTH AFRICAN SOCCER PLAYERS' DIETARY INTAKE: A NEED FOR INTERVENTION?

Ntsako Wisdom Mboweni[1,2], Mosa Selepe[3,4] & Sylven Masoga[1,5]

[1]Department of Human Nutrition and Dietetics, University of Limpopo, South Africa
[2]Department of Dietetics, Nkonjeni Hospital, South Africa
[3]Research Administration and Development, University of Limpopo, South Africa
[4]Research Development and Postgraduate Support, University of the Western Cape, South Africa
[5]Nutrition, Fitness, and Health Programme, LUNEX, Europe

ABSTRACT

Introduction: Soccer is a popular sport in the Xikundu area. However, soccer players' dietary intake remains unknown.

Objective: To determine soccer athletes' energy and macronutrient intakes in the Xikundu area in Limpopo province, South Africa.

Methodology: Ninety-seven (97) competitive soccer athletes were randomly sampled from five soccer teams in the Xikundu area, Limpopo province. The dietary intake of athletes was collected using multiple 24-hour-recall questionnaires on different days. The body Mass of the athletes was measured to calculate nutrient requirements. SAMRC Food Finder was used to analyze meal intakes, and mean nutrient intake from the three recalls was considered. The dietary and demographic data were exported onto the SPSS (v.28), and descriptive statistics were applied. Results were compared to the sports nutrition guidelines. Pearson test was used to correlate data, and a probability value (p) of ≤ .05 was a significant criterion to correlate variables.

Results: All athletes were young males aged 21.6±4.2 years. The majority (84.5%) had grade 12 certificates and a few (4.1%) - degrees. More than half (60%) participated in soccer for >4 years. Athletes (74%) trained once per day in a week. Athletes consumed energy (23.0±6.6 kcal/kg/day), carbohydrates (3.0±0.9 g/kg/day), and protein (1.0±0.3 g/kg/day) suboptimal, while fat consumption was optimal (0.7±0.5 g/kg/day). No significant correlation (p>.05) was found between dietary intake with demography and anthropometry.

Conclusion: The soccer athlete's energy and macronutrient intakes were mostly suboptimal to the sports nutrition recommendations.

Keywords: *soccer, energy, macronutrients, rural area, recommendations*

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ORCID
Ntsako Wisdom Mboweni
https://orcid.org/0009-0008-2949-6739
Mosa Selepe
https://orcid.org/0000-0001-7529-4662
Sylven Masoga
https://orcid.org/0000-0002-2799-7926

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INTRODUCTION

Soccer, also called football (Raizel et al., 2017), is an intermittent sport of high intensity (Ksiazek et al., 2020) played by two teams of eleven athletes with a ball. Due to the intense nature of this sport, athletes need to adhere to, among other things, sports nutrition recommendations during training (Ksiazek et al., 2020). These recommendations on energy and macronutrients, including the timing of nutrients (intake before, during, and after training), have the potential to affect sports outcomes (Nepocatych, 2017). Dietary intake and practices deviating from standards may predispose athletes to fatigue, suboptimal sports performance (Nepocatych et al., 2017), and nutrient

deficiencies affecting health soon or later in life (Masoga et al., 2021). Dietary intakes of soccer athletes in some parts of the world report suboptimal nutrient consumption (O'Brien, 2019; Raizel et al., 2017; Devlin et al., 2017). However, those reporting intakes in South Africa (SA), particularly around rural areas of Limpopo province, remain scarce. The province is one of the nine in SA, dominated mostly by rural areas. Xikundu is one of those rural areas located distal (±220 km) from the province's capital city (Polokwane). In this rural area, soccer is one of the leading sports activities youth participate in for recreational and competitive purposes. However, the dietary intake of these soccer athletes in the area remains unknown. Therefore, this research aimed to investigate the dietary intake of this marginalized group in sports to encourage adherence to the nutrition guidelines for optimal health. This, on the other hand, contributes to achieving Sustainable Development Goal number three (3), which focuses on "Achieving good health and well-being." To our knowledge, this research will be the first in the province to report on the dietary intake of soccer athletes in the rural context of Limpopo. Therefore, sports practitioners and athletes themselves may find this research's discoveries relatively interesting.

Carbohydrates

Carbohydrates (CHO) are required to supply energy during the endurance period in soccer (Renard, 2021; Devlin et al., 2017). Yet, it has been reported as the most neglected macronutrient by athletes (Renard et al., 2021). A study involving 41 collegiate distance runners reported that most athletes (73%) consumed suboptimal CHO (6 – 10 g/kg/day) while a few (2.4%) consumed above the recommendation (Beermann et al., 2020). Another study in Limpopo also found that all (100%) of the athletes (bodybuilders) consumed CHO suboptimal to the recommendation (8 – 10 g/kg/day) in their specific sport (Masoga et al., 2019). Similarly, a study involving 26 high-rank professional soccer athletes reported suboptimal CHO intake during a preseason training week elsewhere (Książek et al., 2020). The CHO recommendation for soccer athletes is slightly higher than that of physically active individuals recommended at 5 – 8 g/kg/day (Kerksick et al., 2018; Collins et al., 2021). On the day of the soccer event, athletes are encouraged to consume 1 – 4 g/kg of CHO 2 – 4 hours before the training or competition for adequate glucose supply at the start of sports engagement (Kerksick, 2017). For sports activities lasting 45 minutes or more, for instance, soccer, athletes need to consume 0.7 g/kg/hr of CHO in a 6 – 8% solution every 10 – 15 minutes during the training or competition (Kerksick et al., 2018). The consumption of CHO during the sport engagement is required to supply the muscles with rapid fuel. Thirty minutes immediately after the training session, 1 – 1.5 g/kg of CHO consumption is recommended to support the working muscles (Masoga et al., 2021).

Protein

The multifactorial role of protein in recovery includes facilitating muscle repair, muscle remodeling, and immune function (Heaton et al., 2017). For these reasons, protein intake is critical in soccer. The recommended protein intake for athletes involved in an intense sport such as soccer is 1.2 – 2.0 g/kg/day (Kerksick et al., 2018). To support strength and body composition improvements, protein consumption of 0.25 – 0.40 is encouraged four hours before and immediately after the sports event (Kerksick et al., 2018). However, the amount, quality, and timing of protein intake are essential. Thus, athletes are encouraged to consume 20 – 25 g/day or 0.3 g/kg of high biological

value protein every 3 – 4 hours after sport session co-ingested with CHO (Kerksick et al., 2017; Bonnici et al., 2019) for improved muscle recovery (Phillips et al., 2016).

Dietary Fat

Fat is one of the energy-dense macronutrients that serve as a source of essential fatty acids, energy (Oliveira et al., 2017), and a vehicle for the absorption of fat-soluble vitamins (A, D, E, and K) (Collins et al., 2021). Fat recommendation for athletes remains the same or slightly higher than that of the general population (Kerksick et al., 2018). Even though the recommendation for fat during sport is still vague, extremely low-fat intake of 15 – 20% of total energy (TE) is discouraged (Collins et al., 2021; ACSM/ADA/DC, 2000) as this compromises the absorption of fat-soluble vitamins and storage of glycogen in the muscles (Thomas et al., 2016). On the other hand, excessive fat intake at the expense of other macronutrients, such as CHO and protein, should be avoided. For that reason, an intake of 0.5 – 1.5 g/kg/day is recommended (Kerksick et al., 2018). When expressed in percentages of total energy (TE), fat intake should be 25 – 35% of TE (Collins et al., 2021), with monounsaturated fatty acids at around 13%, polyunsaturated fatty acids at 10%, and saturated fat at ≤7% of TE (Bonnici et al., 2019). Foods containing omega-3 fatty acids, such as fish and plant oils, have been shown to delay the onset of muscle soreness and decrease post-exercise inflammation (Fernández-Lázaro et al., 2024). Oliveira et al. (2017) recommend minimal fat intake in the pre-exercise meal to prevent delays in gastric emptying, thus avoiding gastrointestinal complications such as nausea and bloating. The summary of energy and macronutrient recommendations for soccer athletes is specified in Table 1.

Table 1. *Energy and macronutrient recommendations (Kerksick et al., 2018)*

Variable	Timing of Intake	Recommendations
Energy		**25 – 35 kcal/kg/day**
CHO 5 – 8 g/kg/day	Before training	1 – 4 g/kg, 2 – 4 hours before
	During training	0.7 g/kg/hr of CHO in a 6 – 8% solution
	After training	1 – 1.5 g/kg
Protein 1.4 – 2.0 g/kg/day	Before training	0.25 – 0.40 g/kg
	During training	No specific recommendation
	After training	0.25 – 0.40 g/kg
Fat 0.5 – 1.5 g/kg/day	Before training	No recommendation specified
	During training	Avoid intake
	After training	No recommendation specified

Diet is among other key components for an athlete's optimal performance (Godois et al., 2020) and can be used as an effective intervention to improve sports performance (Janiczak et al., 2024). Therefore, accurate dietary intake assessments using validated tools are vital among athletes. Similar to the non-athlete population, dietary assessment methods such as the 24-hour dietary recall, Food Frequency Questionnaire (FFQ), and a food diary are frequently used in sports (Bailey, 2021). The dietary intake assessment outcomes should then be compared to the dietary reference standards (Waruni et al., 2020) to evaluate nutrient intake adequacy. For this research, the first two dietary assessment methods, 24-hour-recall and

FFQ, were discussed as they were applied to collect athletes' dietary intake.

The 24-hour dietary recall

The 24-hour dietary recall questionnaire collects details of beverages and food consumed by an individual in the previous 24 hours (Dao et al., 2018; Hulton et al., 2022). An individual is required to remember food items and quantities consumed in the previous 24-hour period (Noormohammadpour et al., 2019). The tool has lowered respondents' burden, resulting in a low attrition rate from participants. However, data collection using this tool requires an experienced practitioner to obtain relevant information from the participants (Waruni et al., 2020; Hulton et al., 2022). The 24-hour dietary recall method is often applied by researchers. For instance, Afrifa et al. (2020) assessed the dietary intake of soccer athletes using multiple records (three 24-hour recalls per individual) and considered the average nutrient intake. In another study involving 120 Turkish Football Federation (Ankara) soccer referees, a single 24-hour dietary recall was used to collect the usual dietary intake of participants (Ilhan et al., 2023). Dasa et al. (2023) also applied multiple (three) 24-hour recalls for assessing dietary intake among the 51 female professional soccer athletes in the Norwegian Premier League. In the latter study, the 24-hour recall questionnaire was collected randomly, including training, match, and rest days. Therefore, using the 24-hour-recall to collect the dietary intake among athletes, particularly in soccer, is not unusual. However, to advance on the dietary intake precision, particularly dietary habitual, the 24-hour-recall can be applied together with the Food Frequency Questionnaire (FFQ) (Freedman et al., 2018).

Food Frequency Questionnaire

The FFQ is another effective tool for assessing habitual dietary patterns (Ishikawa-Takata et al., 2021). Since FFQ may not be used as the only tool to assess an individual's food and nutrient intake, its use should also be validated using other dietary assessment methods (Khamis et al., 2021). The application, development, or adaptation of this tool should take into consideration the characteristics of the target population, as food items consumed by different ethnicities and social groups significantly differ (Ishikawa-Takata et al., 2021). The adaptation of the FFQ was applied during a study by Essman et al. (2022) for the assessment of omega-3 fatty acids intake among 31 collegiate women soccer athletes. The questionnaire was brief, with seven questions assessing intake of omega-3 through grouping of foods of similar eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) content. In another study, Khamis et al. (2021) assessed the dietary intake for 130 adults in pastoral settings of Northern Tanzania using FFQ and two 24-hour dietary recalls. The 24-hour dietary recalls were collected on two different days. The first 24-hour dietary recall was administered at the first visit, together with the FFQ, and the second - during the three to four weeks following the initial one. Thus, the combination practice of different dietary data collection instruments increases the validation of the estimated dietary intake of an individual (Freedman et al., 2018).

METHODS

A descriptive study design using a simple random sampling technique was used to obtain 97 soccer athletes from the five competitive soccer teams training in the Xikundu area, Collins Chabane municipality, Limpopo province. All athletes were affiliated members of the soccer teams. Ethical clearance was obtained from the Turfloop Research Ethics Committee (TREC) (TREC/527/2022), while

permission was given by the coaches. Athletes signed the informed consent before participating in the study. Data collection took place during the off-season (non-competitive) period at the five soccer grounds in the afternoons before the training sessions. Characteristics data included, for example, age, years of soccer experience, duration, and frequency of training. Dietary intake was collected using multiple 24-hour-recall questionnaires on three different days: Mondays, Wednesdays, and Fridays. These multiple recalls were aimed at covering variations in eating patterns during weekdays and over the weekend. During dietary data collection, athletes were asked to recall all food items and fluids consumed in the past day. To minimize recall bias, the researchers used marked household utensils, which included cups, bowls, and spoons, so that athletes could quickly estimate the quantities of their intakes. Furthermore, probing questions using incidents such as social gatherings that athletes engaged in or distinct environments visited during the previous day were inquired to assist athletes during the recall process. Weight and height were also measured with a mobile flat scale (model-874) and portable stadiometer (model-213) from Seca company to calculate body mass index (BMI) and determine energy and macronutrient requirements. Procedures undertaken during the measurements of anthropometry were in accordance with standards by Lee and Nieman (2013). Dietary intakes were loaded into the South African Medical Research Council (SAMRC) Food Finder (version 3), and the mean energy and macronutrient intakes from the three recalls were considered. The dietary intake, anthropometric, and demographic data were then exported from an Excel spreadsheet onto the Statistical Package for Social Sciences (SPSS) (version 28), and descriptive statistics (percentages, mean, and standard deviation [±*SD*] values) were used to describe the dietary intake of athletes. Dietary intake results were compared to the sports nutrition recommendations by the International Society of Sports Nutrition (ISSN) (2018) to determine intake adequacy. Athletes consuming nutrients that are suboptimal, optimal, or excessive to the recommendations were reported. The Pearson correlation coefficient (*r*) test was used to determine the association between the dietary intake and the characteristics of athletes. A probability value (*p*) of ≤.05 with a confidence interval of 95% was a significant criterion to correlate the variables.

RESULTS

The aim of this research was to determine the dietary intake (energy and macronutrients) of soccer athletes in the Xikundu area, Limpopo province. Ninety-seven athletes participated, all of whom were young males (21.6±4.2 years). The majority (84.5%) had grade 12 certificates, while a few, 11.3% and 4.1%, had a diploma and degree certificates. Almost all athletes were not married (88.7%) and unemployed. More than half of the athletes (60%) had been practicing soccer for more than 4 years, while the rest, 27% and 13%, had participated for 2 – 4 and < 2 years, respectively. Athletes (74%) trained once daily for almost the whole week. Most athletes (86.6%) consumed 2 – 3 meals daily, followed by those (9.2%) who consumed four or more meals daily.

The anthropometric status of the athletes is reported in Table 2. The majority (84.5%) of the athletes had optimal body weights (21.7±2.1 kg/m^2) compared to a few who were either underweight (7.2%) or over-weight (8.2%).

Table 2. *Anthropometric status of athletes*

Variable	Min	Max	Mean ±SD	Underweight	Optimal weight	Overweight
Weight (kg)	41.0	89.0	64.1±8.7	-	-	-
Height (m)	1.49	1.86	1.71±0.7	-	-	-
BMI (kg/m^2)*	17.0	29.4	21.7±2.1	7.2%	84.5	8.2

**World Health Organisation (2011)*

Table 3 summarises the athletes' energy and macronutrient intakes. According to this Table, the majority of athletes consumed energy (59.7%), CHO (94.8%), and protein (71.1%) suboptimal. However, 65.9% of athletes consumed fat adequately.

Table 3. *Energy and macronutrient intake of athletes*

Variables	Recommendation	Min	Max	Mean ±SD	Below (%)	Within (%)	Above (%)
Energy	25 – 35 kcal	5.0	39.7	23.0±6.6	59.7%	30.9%	9.2%
CHO	5.0 – 8.0 g	1.4	5.6	3.0±0.9	94.8%	5.1%	0%
Protein	1.2 – 2.0 g	0.5	2.1	1.0±0.3	71.1%	23.7%	5.1%
Fat	0.5 – 1.5 g	0.3	1.3	0.7±0.5	20.6%	65.9%	13.4%

Table 4 shows the correlation between energy macronutrients and athletes' characteristics. However, no significant correlation (p>.05) was found between dietary intake and some demographic information of athletes.

Table 4. *Correlation between dietary variables and characteristics of athletes*

Variables	Energy	CHO	Protein	Fat
		p-value (*r)		
Age	0.287 (-.109)	0.442 (-.079)	0.392 (-.088)	0.191 (-.0134)
Years participating in soccer	0.048 (-.201)	0.019 (-.238)	0.420 (-.083)	0.164 (-.143)
Employment	0.683 (.042)	0.767 (.031)	0.866 (.017)	0.559 (.060)
Marital staus	0.875 (-.016)	0.879 (.020)	0.500 (-.069)	0.710 (-.038)
BMI	0.972 (-.004)	0.977 (-.003)	0.581 (-.057)	0.459 (-.076)

**r=pearson's correlation*

DISCUSSION

The aim of this research was to determine the dietary intake (energy and macronutrients) of soccer athletes in the Xikundu area, Limpopo province. This research found that soccer athletes consumed energy, CHO, and protein suboptimal while fat was optimal. Athletes consumed 2 – 3 meals per day. These results are comparable to those of a study conducted in Ghana among soccer athletes. This study found that the majority (77.9%) of athletes consumed 2 – 3 meals per day, while 22.1% consumed one meal (Afrifa et al., 2020). In another study, a similar finding of 2 – 3 meals per day consumption by more than 90% of athletes was reported in Limpopo by Masoga et al. (2021). The consumption of three meals or less per day in this study could be instituted upon the high unemployment status reported in this group.

The energy intake by more than half (59.7%) of the athletes in this study was below

the recommendation. These results are comparable to those by Makhafola et al. (2022), who reported that most of the athletes (48%) in their study consumed energy (39.6 kcal/kg) suboptimal. Other studies by Masoga et al. (2021) and Jenner et al. (2018) also found that more than half (54.8%) and all (100%) of the athletes consumed energy below the recommendations. Similar to energy, the CHO consumption by almost all athletes (94.8%) in this study was also suboptimal (3.0 g/kg). These results are comparable to those reported by other researchers (Jenner et al., 2018; Masoga et al., 2021; Machuh et al., 2022) who, in their research, found that all athletes (100%) consumed CHO sub-optimal (2.4 g/kg; 3.3 g/kg; 3.6 g/kg) to recommendations. In another study by Makhafola et al. (2022), sub-optimal CHO intake was reported in almost all soccer athletes (92%) in Limpopo. It is, however, to some extent surprising to obtain suboptimal energy and CHO consumption in this study, as energy and CHO-containing foods are known to be mostly consumed across the Limpopo province (Maliwichi et al., 2012). Energy- and CHO-rich foods such as maize meal porridge, rice, potatoes, and bread are highlighted to have various benefits toward optimal health (Vorster et al., 2013). The suboptimal consumption of energy and CHO in this research can easily predispose athletes to early fatigue during training sessions since CHO are the primary fuel source for the muscles and brain (Renard et al., 2021; Hulton et al., 2022).

Protein was consumed suboptimal (1.0 g/kg) to recommendations (Kerksick et al., 2018) in our study. This may have significantly reduced the intake of protein from the high biological value sources, potentially predisposing athletes to the risk of essential amino acid deficiencies (Turnagöl et al., 2023). Suboptimal intake of protein was also reported by Masoga et al. (2021), who found most (61.3%) of their participants to be consuming protein below the recommendations. However, this study is contrary to the findings by Jenner et al. (2018), Makhafola et al. (2022), and Macuh et al. (2023), who found in their studies that most of the athletes had adequate protein intakes. In another study involving 23 professional soccer athletes in Slovenia, adequate protein consumption was reported (Macuh et al., 2022). Suboptimal protein intake by our group might be instituted upon the unemployment status of the athletes, possibly not affording to purchase most of the high-quality protein food sources. However, alternative affordable protein sources that include legumes, beans, and lentils could be used to boost intake to optimal protein levels (Turnagöl et al., 2023).

The optimal consumption of fat (0.7 g/kg/day) by the majority (65.9%) of the athletes was different from other macronutrients. Optimal fat consumption is linked with reduced risks of essential fatty acid deficiencies and promotes absorption of fat-soluble vitamins (Liu et al., 2017). The results of this study are comparable to those of Jenner et al. (2018). These authors found that 91% of the professional Australian soccer athletes consumed fat optimally (0.9 g/kg/day). Similar results reporting adequate consumption of fat by athletes were reported in the other two studies elsewhere (García-dávila et al. 2023; Macuh et al. 2022). However, a systematic review of different team sport athletes reported excessive fat consumption among nine training-day studies (Jenner et al., 2019). On the other hand, Masoga et al. (2021) reported that more than half (61.3%) of soccer athletes consume fat below recommendations. It is somewhat surprising that our group has a fat intake that is within the soccer sport recommendations, differing from the latter researchers since athletes in both studies had a few

similar characteristics (same age category, unemployed, and residing in Limpopo province). We suspect, however, that athletes in this study may have slightly over-reported their fat intake compared to other macronutrients during the recall process.

Lastly, this research found no correlation between the dietary intake to characteristics and anthropometric status of soccer athletes. In another study involving 23 soccer athletes, no correlations (p>.05) were found among other macronutrients and anthropometry, except moderately for protein intake and lean body mass (p=.048; r=.39) (Macuh et al., 2022)

CONCLUSION

This research aimed to determine the dietary intake of soccer athletes in the Xikundu area, Limpopo province. Athletes consumed energy, carbohydrates, and protein, which is suboptimal to the sport-specific recommendations. However, fat was consumed optimally. These nutrient imbalances can expose athletes to undesired health and poor sports outcomes sooner or later in life. Therefore, an intervention in the form of dedicated sports health practitioners, such as nutrition experts, is warranted to design meal plans that are nutritionally optimal for this group. These diets should further be monitored to measure their impact on athlete's nutritional status and overall sports performance.

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Corresponding author:
Ntsako Wisdom Mboweni
Department of Dietetics, Nkonjeni Hospital
South Africa
Email: tsakomboweni@gmail.com