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### RESEARCH ARTICLE

## Nutritional Knowledge and Eating Habits of the National Brazilian Futsal Team

### Conocimiento nutricional y hábitos alimenticios de la Selección Brasileña de Fútbol Sala

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## ABSTRACT

**Introduction:** Futsal is a sport that requires nutritional support to support the high-energy expenditure and significant loss of fluids and electrolytes during training and matches. It is important that high-level athletes follow appropriate, evidence-based nutrition. To our knowledge, there is a lack of data on the eating habits and nutrition knowledge of Futsal players. Therefore, this study aims to describe the nutritional knowledge and eating habits of players of the national Brazilian Futsal Team. A secondary aim was to translate the Abridged Nutrition for Sport Questionnaire into Portuguese for use in Portuguese-speaking athletes.

**Material and methods:** This is a cross-sectional and descriptive study. The evaluations were carried out during the preparation period of the Brazilian Futsal Team for the FIFA Futsal World Cup 2020 qualifiers. We evaluated anthropometry (weight, height, body mass index) nutritional knowledge (assessed using a translated version of the Abridged Nutrition for Sport Knowledge Questionnaire) and eating habits (assessed using a validated Brazilian FFQ), as well as supplement use. The translation of the ANSKQ was undertaken using previous validated forward-backward translation procedures.

**Results:** The mean total correct score on the ANSKQ was 12 out of a possible 35 (34.45%). The mean total correct score on the ANSKQ was 12 out of a possible 35 (34.45%). Players had a statistically significantly higher score for "General Nutrition" knowledge than Sports Nutrition Knowledge (47.27% vs 28.53%,  $p < 0.005$ ). Futsal players had infrequent consumption of the food group "Milk and dairy products", and frequent consumption of "Snacks" as well as fruits. Regarding dietary supplements, 46% of athletes said they consume, or previously consumed, with Whey Protein being the most common supplement.

**Conclusions:** There is room for improvement in athletes nutrition knowledge, especially sports specific knowledge. Futsal players may also require education on appropriate supplement use and dietary intake.

**Keywords:** Diet; Athletic Performance; Nutritional Requirements; Sports Nutritional Sciences; Sports.

## RESUMEN

**Introducción:** El fútbol sala es un deporte que requiere un apoyo nutricional para soportar el alto gasto energético y pérdida significativa de líquidos y electrolitos durante los entrenamientos y partidos. Por tanto, este estudio tiene como objetivo describir el conocimiento nutricional y los hábitos alimenticios de los jugadores de la Selección Brasileña de Fútbol Sala. Un objetivo secundario fue traducir el Cuestionario abreviado de conocimiento sobre Nutrición para el deporte (ANSKQ) para su uso en atletas que hablan portugués.

**Material y métodos:** Se trata de un estudio descriptivo y transversal. Las evaluaciones ocurrieron durante el período de preparación de la Selección Brasileña de Fútbol Sala para las eliminatorias del Mundial de Fútbol Sala FIFA 2020. Evaluamos la antropometría (peso, altura, índice de masa corporal), el conocimiento nutricional (versión traducida del ANSKQ) y los hábitos alimentarios (FFQ brasileño validado), así como el uso de suplementos. La traducción del ANSKQ se llevó a cabo utilizando procedimientos de traducción previamente validados.

**Resultados:** La puntuación media de aciertos en el ANSKQ fue de 12 (de 35) (34.45%). Los jugadores obtuvieron una puntuación estadísticamente significativa más alta en el conocimiento de "Nutrición general" que en el Conocimiento de nutrición deportiva (47,27% frente a 28,53%,  $p < 0,005$ ). Los jugadores de fútbol sala tenían un consumo poco frecuente del grupo "Leche y productos Lácteos", y un consumo frecuente de "Snacks" y frutas. A respecto de los suplementos alimenticios, el 46% de los deportistas afirmaron consumir, o haber consumido, siendo la proteína de suero el suplemento más habitual.

**Conclusiones:** Hay margen de mejora en el conocimiento nutricional de los atletas, especialmente en los conocimientos específicos de nutrición deportiva. Los jugadores de fútbol sala también pueden requerir orientación sobre el uso apropiado de suplementos y la ingesta dietética.

**Palabras clave:** Dieta; Rendimiento Atlético; Necesidades Nutricionales; Ciencias de la Nutrición y del Deporte; Deportes.

## KEY MESSAGES

- There is room for improvement in athletes' nutrition knowledge, especially sports-specific knowledge.
- Futsal players may also require education on appropriate supplement use and dietary intake.
- The translation of the ANSKQ was efficient to assess the nutritional knowledge of high-level athletes.

## INTRODUCTION

Futsal is an intermittent sport, in which intense physiological and motor demands occur during game time. A futsal match consists of two periods of 20 minutes, however, with the stopwatch breaks, the time for a complete match can reach 75 minutes. It is estimated that 3/4 of the match time is high intensity, with players performing at greater than 85% maximum heart rate (HRmax)<sup>1</sup>. In addition, a high-performance futsal athlete (except goalkeeper) runs 3-5 km per match, with, approximately 50% of running being high intensity (> 90% HRmax)<sup>1,2</sup>.

Consequently, high-performance futsal players have high energy expenditure and significant fluid and electrolyte losses during activity<sup>3,4</sup>, and therefore need adequate nutritional support. An appropriate diet contributes to adaptations to training, and optimizing performance and recovery level/time after training or match play<sup>5,6</sup>. While there are no futsal-specific nutrition guidelines, in general, an athlete playing high intensity sports must consume a diet that fully meet their nutritional needs, containing adequate energy (146 kJ/kg fat free mass)<sup>7</sup>, carbohydrate (up to 6-10g/kg body weight/day)<sup>8,9</sup>, protein (1.2 – 1.6 g/kg body weight/day)<sup>7,10</sup> as well as adequate fat and micronutrients.

Despite the important role that diet plays in athletic performance, professional athletes, including futsal players, have nutritional deficiencies and dietary inadequacies<sup>6,11-13</sup>. Recently, a systematic review showed that team-sports athletes generally do not consume adequate carbohydrate<sup>11</sup>. In relation, Heaney et al. (2008)<sup>14</sup> reported that even when caloric consumption is adequate, athletes follow population trends in relation to the distribution of nutrients, and thus dietary pattern is unbalanced in relation to recommendations. In general, athletes diets are characterized by higher than appropriate intakes of fats and proteins and lower than appropriate intakes of carbohydrate. Low carbohydrate intake is problematic because carbohydrate is essential as an energy substrate during exercise. Inadequate carbohydrate intake has an effect on sports performance and physiological markers such as hormone levels and bone mineral density<sup>6,15</sup>.

Diet is influenced by social, cultural, economic, behavioural, and several other factors<sup>12,15,16</sup>. Many variables may explain poor diets in athletes, and understanding the relationship between these variables is essential to promoting healthy eating habits amongst athletes. Nutritional knowledge stands out as a modifiable factor influencing eating habits. Nutritional knowledge is an individual cognitive process related to diet and nutrition, as well as food choices and their preparation<sup>17</sup>.

Several researchers have evaluated the nutrition knowledge of athletic populations. A 2016 literature review of 36 studies concluded nutrition knowledge of athletic groups as whole is difficult to ascertain due to use of heterogeneous questionnaires, but reported that many included studies found athletes had poor nutrition knowledge, with particular gaps in knowledge of energy density, protein and supplements<sup>18</sup>. A 2019 review of the effectiveness of nutrition education programs for athletes found baselined scores of just 59%; while there is no set cut-off to determine adequate knowledge, it is fair to assume that mean scores of 59% indicate significant room for improvement in athletes understanding of concepts related to nutrition<sup>16</sup>.

Previous research has shown a positive association between nutritional knowledge and healthy eating habits in athletic populations<sup>12,19</sup>. However, the relationship between nutrition knowledge and dietary intake is not yet fully understood in high-level sports<sup>12,16</sup> and data is lacking for many sporting populations, including futsal players and Brazilian athletes. Sedek et al. (2014)<sup>20</sup> included futsal players in their study of Malaysian athletes, however results were not stratified by sport, and thus the nutrition knowledge of Futsal players is not able to be determined; to our knowledge no other studies in Futsal players have been conducted. Nutrition knowledge of Brazilian track and field, triathlon athletes has been reported as 80% when assessed using a simple 12-point questionnaire<sup>21</sup>. Adolescent Brazilian soccer<sup>22</sup>, volleyball players<sup>23</sup> have been reported to have a nutrition knowledge of 55%, 57% respectively, with nutrition knowledge positively correlated with better dietary intake the soccer players, a nutrition education program found to lead to positive food practices in the study in volleyball players. We did not identify any studies on the eating habits and nutrition knowledge of Brazilian adult team sports athletes.

In general, it is known that the assessment and identification of gaps in nutritional knowledge is valuable in the planning and development of nutritional education activities that aim to expand the knowledge of athletes about food, nutrition and sports performance<sup>12,15,24,25</sup>. Accordingly, in order to plan effective nutrition education programs for High-level Brazilian futsal players, it is important to understand what the currently level of nutrition knowledge of futsal players, whether these athletes have greater knowledge of sports nutrition or general nutrition, and what (of any) gaps in knowledge exist. Similarly, it is relevant to understand what the eating habits of high-level futsal athletes, that these can be compared to guidelines on intake to optimize athletic performance.

Give the potential positive relationship between nutrition knowledge and food habits, improving nutrition knowledge is an objective of interventions administered by nutritionists. Identification of gaps in nutritional knowledge is valuable when planning and developing nutritional education activities that aim to broaden athletes' understanding of food, nutrition and sports performance<sup>12,15,16,24</sup>. In this context, this study aims to describe the nutritional knowledge and eating habits of players of the national Brazilian Futsal Team. A secondary aim was to translate the Abridged Nutrition for Sport Questionnaire into Portuguese for use in Portuguese-speaking athletes. It is hypothesized that, similar to other athletes, there will be gaps in athletes nutrition knowledge and disparity between recommended and actual nutrition intake.

## **MATERIAL AND METHODS.**

### *Study design and procedures*

This is a cross-sectional and descriptive study. The evaluations were carried out during the preparation period of the national Brazilian Futsal Team for the FIFA Futsal World Cup 2020 qualifiers. The sample of the present study, selected for convenience, includes 15 futsal players. All athletes are Brazilian, but they play in seven elite futsal clubs in the world, distributed in three countries (Brazil, Spain and Portugal). Initially, the team's technical committee was contacted, at which time the objectives of the present study were presented. After acceptance for participation in the research by all involved (technical committee and athletes), two consecutive days of assessments (anthropometric measurements, nutritional knowledge, food intake) were scheduled. On the two scheduled days, before the beginning of the procedures, the objectives, risks and benefits of the evaluations carried out were again presented to all participants and the athletes signed the Informed Consent Form. The research project was approved by the ethics committee of the Federal University of Rio Grande do Sul (number 2903811). The questionnaires were administered under the supervision of a trained nutritionist. After a brief explanation about how to fill out the questionnaires, the athletes completed the questionnaires individually.

### *Anthropometric Measurements*

The anthropometric measurements were carried out by a team of duly trained assessors. The evaluations were carried out at the Exercise Research Laboratory, at the Universidade Federal do Rio Grande do Sul. The athletes' body mass was evaluated using a mechanical scale (Filizola brand, with a capacity of 150 kg), the height was informed by the technical committee researchers, data

obtained through their internal evaluations. From this information, the values of the Body Mass Index (BMI) were calculated.

#### *Nutrition Knowledge Questionnaire Development*

##### *Forward-Backward Translation*

The instrument initially was sent to two native Brazilian Speakers, who are also fluent in English, the original language of the instrument; they independently translated the English version to Portuguese (forward-translation). In next step, the newly translated Portuguese version was sent to two other translators, who independently translated the questionnaire back into English (back-translation). The English version was cross-checked by the developer of the original ANSKQ<sup>26</sup>, who confirmed that meaning had been retained in the forward-backward translation process. Finally, all four translators met to produce the final version of the questionnaire in Portuguese.

##### *Content Validation*

The final Portuguese version of the tool was sent to three specialist sports nutritionists. The selection of these specialists was carried out by curriculum consulting. The specialists independently assessed the clarity and relevance of each questionnaire item, and proposed modifications to improve these. After the experts' evaluation, the possible changes were reviewed and implemented, if deemed relevant. The modified version of the questionnaire was resent to the experts and translators, who all approved the tool.

##### *Nutritional Knowledge Assessment*

A nutritionist applied the questionnaire. To assess nutritional knowledge, the updated "Abridged Nutrition for Sport Knowledge Questionnaire (A-NSKQ)"<sup>25,26</sup>, developed to assess the nutritional knowledge of athletes, especially the concepts domain related to sports nutrition. This instrument was validated for use with athletes of different nationalities, levels of competition and sports. All questionnaire are composed of multiple-choice questions with three or four alternative answers (including a 'not sure' option) and just one correct answer. The questionnaire contains 35 questions, divided into two subsections. The first section contains 11 questions about general nutrition knowledge; the second section contains 24 questions about sports nutrition specifically.

### *Eating habits*

The assessment of eating habits was carried out using a validated Food Frequency Questionnaire (FFQ)<sup>27</sup>. The FFQ is a Brazilian instrument, original version in Portuguese, with 52 food items divided into 10 food groups. The frequency of consumption categories present in the instrument are: a) once a day; b) twice or more a day; c) four to six times a week; d) two to three times a week; e) once a week; f) once a month; g) twice or more times a month; h) rarely or never. In addition, the instrument assesses the average portion consumed, in homemade measures and/or grams and millilitres.

### *Statistical Procedures*

The data were analyzed using the SPSS software (IBM, USA), version 20.0 For data analysis, descriptive analyses were used, with relative frequencies, means, standard deviation (SD), minimum (MIN) and maximum (MAX). A dependent t-test was carried out to describe possible differences between the general nutrition knowledge and sports nutrition specifically. Given the relatively small, and heterogeneous sample size it was not relevant to conduct group comparisons or assess associations between demographic variables and nutrition knowledge, eating habits in this study. As such, no additional inferential statistics have been applied.

## RESULTS

The characteristics of the participants that completed the evaluations are described in Table 1. The sample was exclusively male, aged 21–35 years. Five athletes play in Brazil and 10 athletes play in other countries leagues.

**Table 1.** Sample characteristics.

	<b>Mean (<math>\pm</math> SD)</b>	<b>Minimum – Maximum</b>
Age (years)	29.27 $\pm$ 4.20	21 - 35
Body Mass (kg)	80.43 $\pm$ 7.53	63.60 – 88.80
Height (cm)	178.27 $\pm$ 3.26	175 - 185
BMI (kg/m <sup>2</sup> )	25.29 $\pm$ 2.05	20.30 – 28.18
Futsal club (country)	n (%)	
Brazil	5 (33%)	
Spain	6 (40%)	
Portugal	4 (27%)	

BMI: Body Mass Index; SD: standard deviation; n: number; %: percentage values.

Table 2 describes the results obtained from the assessment of nutritional knowledge. The total, mean correct score was 12 (34.45%). Players had a statistically significantly higher score for “General Nutrition” knowledge than Sports Nutrition Knowledge (47.27% vs 28.53%,  $p < 0.005$ ). A response rate of 100% (n = 15) was achieved. All A-NSKQ were completed correctly and included in the analyses.

**Table 2.** Results of nutritional knowledge assessment

	<b>Total Questions</b>	<b>Mean Scores (<math>\pm</math> SD)</b>	<b>%</b>	<b>Min.</b>	<b>Max.</b>
General Nutrition	11	5.20 ( $\pm$ 1.14)	47.27	3	7
Sports Nutrition	24	6.86 ( $\pm$ 2.35)	28.53	3	11
Total	35	12.06 ( $\pm$ 2.81)	34.45	7	17

The results of the Food Frequency Questionnaire are shown in Table 3. The athletes had great difficulty in approximating portion sizes. Therefore, we have not converted food consumption into quantitative nutrient values, rather have focused on the frequency in which food groups and specific foods were reportedly consumed.

Consumption of “Milk and dairy products” was infrequent, with 40% and 80% of the athletes reporting they rarely or never consumed skimmed / semi-skimmed milk and whole milk,

respectively. In the "Meat and meat products" group, most athletes claimed to consume beef, chicken and fresh fish "once a week" and "2 - 4 times a week ", respectively. Also of note, in the "Cereals / Legumes" group, the consumption of whole foods, such as bread and rice, was less frequent than the consumption of white bread and polished rice.

In the "Vegetables and Fruits" group, consumption of raw fruits and leaves was frequent. With 73.3% of athletes consuming fruits at least 5 days a week, furthermore, no athlete mentioned not eating fruit. In contrast, the consumption of vegetables was infrequent. There was also an infrequent consumption of the group "Desserts and sweets" and "Diet and light products". In relation to "Drinks", the frequent consumption of soft drinks stands out, with 66% of athletes consuming soft drinks at least once a week. In the "Oils" group, consumption of foods with a high saturated fat content and low nutritional value, such as butter and bacon, margarine and mayonnaise, was infrequent.

**Table 3.** Food Frequency Questionnaire.

PRODUCTS	Two or more times a day	Once a day	5 – 6 times a week	2 - 4 times a week	Once a week	1 – 3 times a month	Rarely or never
<b>Milk and dairy products:</b>							
Reduced-fat milk (2%), low-fat milk (1%)	6.7	46.7	0	0	0	6.7	40
Milk	0	6.7	0	0	13.3	0	80
Yogurte	6.7	20	6.7	33.3	13.3	0	20
White Cheese (minas/frescal)	6.7	0	0	0	26.7	13.3	53.3
Cheese (cheddar/plate/mozzarella)	6.7	6.7	20	26.7	0	0	40
Cream Cheese	0	6.7	0	0	13.3	20	60
<b>Meat and meat products:</b>							
Fried egg	6.7	6.7	0	20	33.3	6.7	26.7
Boiled Eggs	0	13.3	6.7	33.3	0	13.3	33.3
Beef (Red meats)	0	20	13.3	53.3	0	6.7	6.7
Pork	6.7	0	0	13.3	6.7	33.3	40
Chicken	0	13.3	26.7	53.3	6.7	0	0
Fish	0	0	0	13.3	33.3	26.7	26.7
Canned Fish	0	0	0	0	13.3	26.7	60
Cold cuts (Coppa salami, ham, salami...)	0	0	13.3	20	13.3	6.7	46.7
Beef Jerky	0	0	13.3	6.7	6.7	20	53.3
Offal (Heart/kidney/liver)	0	0	0	0	0	20	80
<b>Oils:</b>							
Oil	0	46.7	13.3	26.7	0	0	13.3
Salad dressing	0	6.7	0	6.7	6.7	6.7	73.3
Bacon	0	0	0	6.7	13.3	6.7	73.3
Butter	13.7	6.7	6.7	6.7	13.3	26.7	26.7
Margarine	6.7	0	0	20	13.3	26.7	33.3
Mayonnaise	0	0	6.7	0	20	40	33.3
<b>Snacks and canned food:</b>							
Snacks	0	0	0	53.3	26	6.7	13.3
Canned Foods (corn, pea, beans...)	0	0	0	6.7	40	20	33.3
<b>Cereals and pulses:</b>							
Brown/Whole Rice	0	0	0	20	33.3	0	46.7
White Rice	6.7	13.3	26.7	20	0	0	33.3
Whole grain bread	0	13.3	0	40	13.3	6.7	26.7
Bread slice/roll	13.3	0	0	33.3	26.7	13.3	13.3
Cream cracker	6.7	0	0	13.3	26.7	6.7	46.7
Cookies	0	0	0	26.7	33.3	13.3	26.7
Cakes	0	0	6.7	0	40	26.7	26.7
Noodles (spaguetti, macaroni)	13.3	6.7	13.3	60	6.7	0	0
Beans	0	13.3	20	33.3	6.7	13.3	13.3
<b>Vegetable and Fruit:</b>							
Lettuce leaves	6.7	26.7	40	13.3	0	6.7	6.7
Braised collard greens	0	6.7	20	33.3	0	0	40
Raw vegetables	0	0	20	46.7	13.3	0	20
Cooked vegetables	6.7	0	20	20	6.7	6.7	40
Tubers (potato/sweet potato/casava)	0	0	0	53.3	26.7	20	0

Fruits	0	40	33.3	13.3	13.3	0	0
<b>Desserts and jams</b>							
Ice Cream	0	0	0	0	26.7	40	33.3
Pies	0	0	0	0	20	33.3	46.7
Sweet jam	0	6.7	0	0	6.7	13.3	73.3
Sweets/candies	0	0	0	26.7	33.3	0	33.3
Chocolate candy/chocolat	0	13.3	6.7	20	26.7	6.7	26.7
<b>Drinks:</b>							
Coffee with sugar	0	13.3	6.7	13.3	13.3	6.7	46.7
Coffee without sugar	20	26.7	6.7	0	0	6.7	40
Natural juice (fruits) with sugar	0	6.7	6.7	20	13.3	6.7	46.7
Natural juice (fruits) without sugar	6.7	6.7	6.7	13.3	20	6.7	40
Artificial Juice with sugar	0	6.7	0	13.3	13.3	6.7	60
Artificial Juice without sugar	0	6.7	0	0	13.3	0	80
Soft drinks (Coca Colca, Pepsi, Sprite)	0	0	0	6.7	66.7	20	6.7
Alcoholic Drinks	0	0	0	13.3	40	20	26.7
<b>Diet and Lght:</b>							
Sweetner	0	6.7	0	0	6.7	6.7	80
Margarine diet/light	0	0	0	6.7	13.3	13.3	66.7
Cream cheese diet/light	6.7	0	6.7	13.3	20	6.7	46.7
Soft Drinks diet/light	0	0	0	0	46.7	6.7	46.7

Table 4 shows the results regarding the consumption of dietary supplements, where 46% (n = 7) of the group claimed to use or have used supplements. Whey Protein was the most mentioned supplement among athletes and was used by 88% (n = 6) of athletes who reported they currently or previously used supplements.

**Table 4.** Consumption of Food Supplements.

<b>Frequency</b>	<b>n</b>	<b>%</b>
Use/Used	7	46.6
Never used	8	53.3
<b>Supplement consume</b>	<b>n</b>	<b>%</b>
Whey Protein	6	85.7%
Creatine	2	28.5%
BCAA	1	14.2%
Glucosamine	1	14.2%
Chondroitin	1	14.2%
Maltodextrin	1	14.2%

## DISCUSSION

This study aimed to describe the nutritional knowledge and eating habits of players of the national Brazilian Futsal Team. The main results of this study are: 1) the evaluated futsal players had poor nutrition knowledge and scored better in the general nutrition knowledge than sports nutrition knowledge topics; 2) the evaluated futsal players had infrequent consumption of the food group "Milk and derivatives", frequent consumption of "Snacks" (french fries, sandwiches, pizza, sfiha, snacks, peanuts), and frequent consumption of fruit.

### *Nutrition Knowledge*

To our knowledge, this is the first study nutrition knowledge of high-performance futsal players. The National Brazilian Futsal Team is a very special sample, considering the futsal league is relatively small, and the Brazilian team is a prominent team in the world, yet they demonstrated poor nutrition knowledge (35%). Overall, studies with high-level athletes are scarce, limiting comparisons between our findings and other published studies. Sedek & Yih <sup>20</sup> evaluated the nutrition knowledge and diet habits of 100 university level athletes in Malaysia, and included 8

futsal players in the sample, but results were not presented stratified by sport; reported nutrition knowledge in this study was 85%, much higher than results in the present study. The nutrition knowledge scores in this study were lower than previous studies that have used the A-NSKQ in Australian elite and non-elite mixed-gender athletes, who scored 46% overall- 59% in the general nutrition knowledge section and 35% in the sports nutrition knowledge section<sup>28</sup>. More recently, the NSKQ or ANSKQ was used to evaluate nutrition knowledge of Gaelic Football/games players and elite squash players, with scores ranging from 40.2%<sup>29</sup> to 56.7%<sup>30</sup> (40.2% in male, club/county Irish Gaelic Football players<sup>29</sup>, 46.0% in female Gaelic games players<sup>31</sup>, 47.8% in elite and non-elite Gaelic Football Players<sup>32</sup> and 56.7% in elite squash players<sup>30</sup>).

The differences between previous studies and our study may be explained by the differences in general education, which is known to impact nutrition knowledge. Likewise, there may be a lack of access nutrition professionals. In Brazil, even in large teams, the nutritionist is not present in most technical committees, and thus athletes may be using alternate (non-nutrition professional) sources of information. Previous studies have suggested that the low level of nutritional knowledge amongst athletes can be explained by use of non-reputable information sources, such as websites, social networks, friends and coaches. We were not able to assess nutrition information sources of athletes. Juzwiak et al.<sup>33</sup> reported that Brazilian coaches frequently provide nutrition information to adolescent Brazilian athletes, but published data on the information sources and access to nutrition services of other Brazilian athletes and futsal players is limited.

The finding that evaluated athletes have greater general than sports nutrition is in line with previous studies in American athletes<sup>19</sup> and Australian athletes<sup>28</sup>. Athletes may be exposed to general nutrition information via friends, family members and campaigns to promote healthy eating by the media. In contrast, sports specific nutrition information is more niche and complex. Therefore, a likely explanation for this finding is that athletes are exposed more to general, rather than sports specific information. The difference between general and sports nutrition knowledge was not only statistically significant, the magnitude of the difference was relatively large (approx. 20%). Therefore, it is likely that athletes have some knowledge about general concepts related to healthy eating but are much less aware of current evidence-based, sports specific strategies. General nutrition knowledge is still highly relevant for athletes, and it is likely they would obtain performance benefits by simply improving general diet quality, and getting the basics' of their diet correct; knowledge and application of sports specific strategies is likely to have additive, additional benefits in terms of sport performance.

### *Eating Habits*

To our knowledge, this is the first study eating habits of high-performance futsal players. There was a high percentage of athletes who mentioned rarely consuming, or not consuming milk products and milk derivatives, and athletes over-consumed processed foods, with 53% of athletes reporting to consuming “Snacks” 2-4 times per week. Due the nature of the way diet was assessed, it is not possible to directly compare our findings to existing studies. The food frequency analysis does, however, indicate that diet quality was poor and not in-line with recommendations. This finding would not be surprising, as poor diet quality amongst team athletes is common<sup>11</sup>.

Maintaining appropriate eating habits contributes to sports performance, and is important before and during activity, as well as for recovery after exercise<sup>5,12,15,34</sup>.. It is likely that these athletes will benefit from support from nutrition professionals, in order to improve nutrition knowledge and dietary intake. Specifically, education should ensure athletes have understand basic concepts of sports nutrition, related to hydration, pre and post exercise meals, which are fundamental for a good performance in sports practice<sup>5,35</sup>

In relation to our finding regarding milk products; milk and its derivatives are an important source of calcium and proteins, and the adequate intake of this mineral is essential for the health and performance of athletes<sup>36</sup>. The need for calcium may be greater for athletes than the general population, due to their intense participation in muscle contraction and losses of this mineral, mainly in sweat during activity<sup>34,36</sup>. Futsal is considered a sport with potentially positive stimuli for bone mineral density, however, the nutritional contribution will be important to achieve these positive effects<sup>36</sup>. Alongside basic sports nutrition information, this information can be important for planning nutritional interventions, where the health benefits of calcium are emphasised, and/or consumption of alternative sources of calcium, such as dark green vegetables, is encouraged. In relation, education may focus on discouraging excess consumption of processed snack foods because these products mostly have low nutritional value, with a high caloric value, high sodium and fat content<sup>37-40</sup>.

### *Strengths*

The strengths of this study are that it is an important first step in assessing and presenting data regarding the level of nutritional knowledge and eating habits, of a very particular sample — high level futsal athletes. We also successfully translated a validated questionnaire into Portuguese,

which can now be used in further studies and compared to existing studies that have used the same tool.

#### *Limitations*

A limitation of this study is the relatively small sample size. Given the relatively low number of individual Brazilian athletes involved in high-performance futsal, it is likely the sample is representative of the target group; however, results cannot necessarily be generalised to other athletes. Assessment of other Brazilian athletes has been planned for future studies. A second limitation is the fact that the way the dietary data was collected prohibited us from estimating intake of calories, carbohydrates, proteins, fat and micronutrients. Finally, while we translated a validated tool, due to time constraints, no further, additional validation was undertaken.

#### *Future research*

This study was an important first step in collecting and describing data on the nutrition knowledge and eating habits of high-level Brazilian futsal players – an understudied group. Given the lack of studies in this area, there is great scope for further research to address the limitations of the current study and expand the field. Future research should focus on (1) Larger sample sizes and more diverse groups of athletes (2) More in-depth dietary data collection that allows for analyses of macronutrient intake and compliance with sports-specific recommendations (3) Investigation of the type of nutritional support athletes have in the teams in which they play, which would allow better understanding of why nutrition knowledge is poor (4) development and evaluation of education programs, and finally (5) Further psychometric evaluation of the Portuguese ASNKQ.

## CONCLUSION

In conclusion, the athletes of national Brazilian Futsal Team had poor nutrition knowledge, but presented greater nutritional knowledge related to nutrition issues in general when compared to the subsection sports nutrition. This is concerning due to the strong relationship between eating habits and sports performance, especially when it comes to a sport like Futsal, which requires a great nutritional contribution from athletes.

Regarding eating habits, our study found most athletes had infrequent consumption of the group "Milk and dairy products", frequent consumption of "Snacks" and frequent consumption of fruits. This is concerning, given these foods contain nutrients that are important for athletic performance. It is understood that improving nutritional knowledge may lead to the adoption of better eating habits, and consequently, contribute to the sports performance and health in general of high-level athletes. Therefore, our findings indicate the need for nutrition education programs amongst Brazilian futsal athletes.

Finally, the translation of the Abridged Nutrition for Sport Questionnaire into Portuguese was successful, and it was possible to assess the knowledge of athletes with the Portuguese version, without any type of incompatibility. This is promising for future research in the field.

### **AUTHOR CONTRIBUTION.**

MASDJ as the main author participated in all phases of this work. GLT is the author of the nutritional knowledge questionnaire used, contributed to data analysis and article writing. JBM and RCV contributed to data analysis and article writing. MXA, RC, CLFM and RSP were coordinators of the evaluations carried out in the laboratory and final reviewers of this article.

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### **COMPETING INTERESTS**

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