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Dietary intake of young portuguese handball players

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ABSTRACT

The aim of this study was to analyse dietary intake (macronutrients and micronutrients) in young female and male handball athletes. A transversal study was performed with young handball players from sub 16 and 18 Portuguese Handball Federation, who volunteered to participate in this study. Anthropometric (weight and height measure), nutritional intake (using food frequency questionnaire) and position in the game were evaluated. The final sample comprised 64 athletes (48.4% female and 51.6% male). The mean age was 16± 1 years, average body mass index was higher in females (24.1± 3.5kg/m²) than males (23.8± 3.0 kg/m²). Mean energy intake per day was significantly lower in females than males 2167.4± 1185.0 and 2952.9± 1315.8 kcal/day (p= 0.015, 95CI), respectively. According to the recommendations from food, most of the young handball athletes reported a generally higher dietary intake (protein intake was near to the upper recommendation limit; the carbohydrate intake was below and the fat intake higher) and a lower for some micronutrients. A process to identify the athletes that need nutritional support should be considered by handball coaches to optimise their performance and safeguard their health.

KEYWORDS: nutrition; food intake; handball; adolescents.

INTRODUCTION

As a collective game, handball involves two teams of seven players each, according to international handball federation rules. Handball is defined as an intermittent high-intensity exercise. Importantly, it also indicates that team handball may potentially result in widespread positive health and physical fitness effects due to the high demands imposed on the aerobic and anaerobic energy systems (Randers et al., 2010; Hornstrup et al., 2020).

Healthy food choices and adequate nutrition for team sports athletes is a challenge. Cultural, economic, and psychological factors can influence but are essential for supporting training and enhancing the physical performance of athletes (Holway & Spriet, 2011).

The players perform various activities such as running (speeding up, slowing down, changing direction and sprint), jumping (jumping and throwing and blocking), throwing balls (giving passes and pitching), and reciprocal physical struggle during the game (Povoas et al., 2012). Anthropometric characteristics of these athletes, such as height, weight and body composition (Ghobadi, Rajabi, Farzad, Bayati, & Jeffreys, 2013), and physical capacities such as speed, power, strength and endurance, and motor action, as the change of direction and jumping, are prerequisites which should be carried out (Molina-Lopez, Barea Zarzuela, Saez-Padilla, Tornero-Quinones, & Planells, 2020). Given its influence on performance, body composition should be appropriate, which depends to a large extent on proper eating habits (Hosseinzadeh et al., 2017).

Adequate food intake is crucial to capable growth and maturity and is associated with physical exercise (Cotunga, Vickery, & McBee, 2005; Bonci, 2010). According to sports nutrition guidelines, protein intake should be between 1.2g/kg/day and 1.7g/kg/day, carbohydrates (Kaur et al., 2006) ingestion

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may range from 3 to 12 g/kg/day depending on the duration and type of exercise (Burke, Hawley, Wong, & Jeukendrup, 2011), and fat should contribute to 20–35% of total energy value (Desbrow et al., 2014; Jenner, Buckley, Belski, Devlin, & Forsyth, 2019). Moreover, athletes should reach, at least, the dietary reference intakes for all micronutrients.

The studies of elite and young handball players' anthropometric nutritional intake tend to be inconsistent. And in a practical context, due to the few nutritional information, this work is a pioneer in assessing the food intake of this group.

As, due to specificity on training according to their position (wings, pivots and backcourt players and goalkeepers), that during the game consequential to field zones and phases of the game, each position player has specific technical and tactical requirements. Athletes from different positions differ in morphological parameters, especially in body weight (between backcourts and wings) and subcutaneous fat (goalkeepers and the other players) (Hermassi, Laudner, & Schwesig, 2019). However, according to the scarce information and competition and rest days in young athletes, it is essential to characterise this population regarding these variables.

This is the first transversal observational study, with the following objectives:

i) to analyse nutritional intake (macronutrients and micronutrients);
ii) to analyse nutritional intake (macronutrients) according to their position in the game and between female and male athletes.

It was hypothesised that nutritional intake (macronutrients and micronutrients) are according to the nutritional recommendations according to the age and regardless of position on the game, all athletes have adequate nutritional intake, being higher in males than in female athletes.

METHODS

This study is a transversal observational study.

Participants

Seventy young handball athletes from different Portuguese clubs volunteered to participate in this study between October and November of 2019. To be eligible for participation, the participants should play in sub 16 and 18 years old, be selected to play for the Portuguese Handball Federation and completed all questionnaires. Six were excluded due to unwillingness to continue participating in the study or missing the completion of the questionnaire. The final sample comprised 64 athletes [48.4% (n= 31) female and 51.6% (n= 33) male].

The study was approved by the research committee of the Portuguese Handball Federation. All participants, their coaches, and parents were informed of study purposes. And guardians signed the informed consent before the study, in accordance with the Declaration of Helsinki, regarding the ethical procedures of the study.

Anthropometric measures

A professional assessed the body composition, including body weight, height, and body mass index (BMI), using a bioelectrical impedance analyser. All anthropometric measurements were performed before the training session. Height was measured using a stadiometer with an accuracy of 0.5 cm (Seca 700, Germany). Bodyweight and BMI were determined using bioelectrical impedance analysis equipment (ioi 353 BIA) with an accuracy of 0.1 kg, 0.1 kg/m^2, 0.1%, respectively. Measurements were done with athletes wearing shorts and t-shirts.

Dietary assessment

Dietary intake was obtained by a semi-quantitative food-frequency questionnaire (FFQ), validated for the Portuguese adult population (Lopes, Aro, Azevedo, Ramos, & Barros, 2007). The participants filled out semi-quantitative FFQ that assessed information over the previous 12 months. The questionnaires were completed in the presence of a qualified and trained nutritionist from November 2019 to February 2020. The FFQ is an 86-item questionnaire that includes food groups and beverage categories and a frequency section with 9 possible responses, ranging from "never or less than 1 time per month" to "6 or more times per day". The food intake was calculated by weighting 1 of the 9 possibilities of frequency of consumption by the weight of the standard portion size of the food item. A seasonal variation factor was considered for foods where production and consumption were not regular over the year. Energy and nutrient intake with more sports relevance (proteins, carbohydrates, lipids, vitamins A, C, E, D, B6, and B12, thiamine, riboflavin, folate, magnesium, zinc, calcium, selenium, and iron) were estimated using the software Food Processor® SQL (ESHA Research Inc. Salem, OR, USA) with proven nutritional information from food composition tables from the United States Department of Agriculture, adapted to typical Portuguese foods and recipes.

Handball Game Position

Each coach was asked about the field position of the elite and young handball players. There are different positions, such as the goalkeeper, wings, pivots and backcourt players.

Statistical analysis

Data were checked for normal distribution using Kolmogorov-Smirnov test. The mean, standard deviation and 95% confidence interval were calculated as descriptive statistics. Independent samples t-test was used for quantitative variables comparison between the female and male. One-way ANOVA was used to analyse the differences in macronutrients between the players' positions (Wing athletes, pivots, backcourt athletes and goalkeepers). Amounts of macronutrients and micronutrients intake were adjusted for their daily energy consumption, using linear regression test and residual method. Differences were considered significant when $p< 0.05$. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 23.0 statistical software for Mac (IBM, Armonk, NY, USA).

RESULTS

Anthropometric characteristics

Of the 70 young handball athletes, 6 were excluded due to incomplete information. The final sample comprised 64 athletes (48.4% female and 51.6% male). Table 1 shows the characteristics of athletes (age and anthropometric characteristics) included in this study. The mean age was 15.5± 0.9 years, and dividing according to sex, the ages of male and female athletes were 16.1± 0.5 and 14.8± 0.9 years ($p= 0.001$), respectively. Male athletes were significantly heavier and taller than females, but the average BMI was higher in females (24.1± 3.5 kg/m^2) than males (23.8± 3.0 kg/m^2). Without significant difference between sex ($p= 0.66$). According to game position, the BMI of female and male pivots' athletes was 26.8± 4.7 kg/m^2 and 26.5± 3.8 kg/m^2 ($p= 0.923$), respectively. Female and male Goalkeepers' BMI was 25.7± 4.2 kg/m^2 and 24.3± 1.8 kg/m^2 ($p= 0.690$), respectively. Female and male backcourt' BMI was 22.8± 2.6 kg/m^2 and 23.6± 2.2 kg/m^2 ($p= 0.406$), respectively. female and male Wings' BMI was 22.6± 1.2 kg/m^2 and 21.1± 2.2kg/m^2 ($p= 0.338$), respectively.

Table 1. Mean values of age and body composition of young handball athletes and the comparison of the variables between female and male.

	Female (n= 31)	Male (n= 33)	*p*
Age (years)	14.8± 0.9	16.1± 0.5	**< 0.001**
Weight (kg)	63.9± 10.0	77.1± 12.1	**< 0.001**
Height (Hermassi et al., 2019)	1.6± 0.1	1.8± 0.1	**< 0.001**
BMI (kg/m^2)	24.1± 3.5	23.8± 3.0	0.66

All variables are present as mean± standard deviation. Statistical analysis with independent t-test, between female and male athletes, respectively: BMI: body mass index.

Nutritional intake

Energy, macronutrients, and micronutrients intake of athletes are provided in Table 2. female and male mean energy intake per day were 2,167.4± 1,185.0 and 2,952.9± 1,315.8 kcal/day ($p= 0.015$, 95CI), respectively. Average energy, protein, carbohydrate, fat, vitamin E, thiamin, folate, magnesium, calcium, zinc and iron intake in males was significantly higher than females ($p< 0.05$). None of these athletes was using nutritional supplements.

Nutritional intake according to game position

Energy and macronutrients intake of athletes, according to their playing position, are provided in Table 3. The mean energy intake per day of wing female and male players was 2,695.2± 1,538.1 and 2,898.9± 1,325.9 kcal/day, respectively. The mean energy intake per day of pivots female and male players were 1,984.9± 1,223.3 and 3,318.2± 1,656.6 kcal/day, respectively. Backcourt athletes' energy intake was 1,802.6± 798.1 kcal/day in females and 2,950.6± 1,116.8 kcal/day in males. Goalkeeper athletes' energy intake was 1,899.1± 711.1 kcal/day in females and 3,837.1± 1,537.8 kcal/day in males. In females, the average macronutrients, there were significant differences in protein intake (g/day) between wing and backcourt female athletes (1,17.7± 38.2 and 80.1± 37.6 kcal/day, $p= 0.045$, respectively).

DISCUSSION

This study assessed the nutritional intake (macronutrients and micronutrients) of young handball athletes as well according to their position in the game and between females and males. The main findings were that young female, and male handball athlete's energy intake is 2,167.4± 1,185.0 and 2,952.9± 1,315.8 kcal/day, respectively (Figure 1). Average energy, protein, carbohydrate, fat, vitamin E, thiamin, folate, magnesium, calcium, zinc and iron intake in males was significantly higher than that of females ($p< 0.05$). Regarding the position in the game, female athletes in wing position have a higher energy intake compared to the other positions. And according to macronutrients intake, wing athletes had a significantly higher protein intake (g/day) than other positions and carbohydrate and lipids intake (g/day). In male athletes, the goalkeepers had a higher energy intake

Table 2. Mean values of energy (kcal/day), macronutrients and micronutrients per day of young handball athletes and the comparison of the variables between female and male.

	Female (n= 31)	Male (n= 33)	*p*
Energy (kcal/day)	2,167.4± 1,185.0	2,952.9± 1,315.8	**0.015***
Macronutrients			
Proteins (g/kg/day)	1.6± 0.8	1.8± 0.9	0.324
Proteins (g/day)	100.2± 50.1	136.3± 64.0	**0.016***
Carbohydrates (g/kg/day)	4.3± 2.5	4.9± 2.8	0.385
Carbohydrates (g/day)	267.1± 144.4	366.4± 190.5	**0.023***
Lipids (g/day)	78.9± 49.1	109.9± 59.7	**0.027***
Omega 3 (g/day)	1.5± 1.0	1.8± 0.9	0.284
Omega 6 (g/day)	11.1± 6.6	14.3± 7.8	**0.085***
Micronutrients			
Vitamin A (ug/day)	2,759.5± 2,562.9	3,309.1± 2,402.1	0.379
Vitamin C (mg/day)	126.7± 104.1	172.5± 142.0	0.149
Vitamin E (mg/day)	9.3± 5.7	12.2± 5.8	**0.046***
Vitamin D (ug/day)	5.2± 4.1	5.4± 3.5	0.832
Vitamin B6 (mg/day)	2.6± 1.5	3.3± 1.7	0.092
Vitamin B12 (ug/day)	16.1± 17.6	18.5± 14.2	0.555
Thiamin (mg/day)	1.8± 0.8	2.4± 1.2	**0.014***
Folate (ug/day)	389.4± 245.3	546.2± 343.6	**0.041***
Magnesium (mg/day)	331.6± 184.4	450.8± 205.8	**0.018***
Calcium (mg/day)	886.9± 464.7	1,326.1± 854.7	**0.014***
Zinc (mg/day)	13.6± 7.1	18.0± 8.4	**0.027***
Iron (mg/day)	17.7± 9.8	23.2± 10.6	**0.035***

All variables are present as mean± standard deviation. *p*-value comparison of variables between female and male adolescents. *$p < 0.05$

Table 3. Mean values of energy (kcal/day), macronutrients per day of young handball athletes and the comparison of the variables between female and male and their position (Wing athletes, pivots, backcourt athletes and goalkeeper) in the game.

	Wing athletes	Pivots	Backcourt athletes	Goal keeper	*p*
Female (n= 31)	**(35.5%)**	**(16.1%)**	**(29.0%)**	**(19.4%)**	
Energy (kcal/day)	2,695.2± 1,538.1	1,984.9± 1,223.3	1,802.6± 798.1	1,899.1± 711.1	
Proteins (g/day)	117.7± 38.2*	105.5± 93.7	80.1± 37.6*	96.8± 35.3	***0.045**
Carbohydrates (g/day)	316.0± 192.9	257.2± 149.3	238.6± 102.95	228.4± 85.2	
Lipids (g/day)	104.4± 65.8	63.5± 34.7	62.4± 33.1	69.6± 29.2	
Male (n= 33)	**(50.0%)**	**(20.0%)**	**(23.3%)**	**(6.7%)**	
Energy (kcal/day)	2,898.9± 1,325.9	3,318.2± 1,656.6	2,950.6± 1,116.8	3,837.1± 1,537.8	
Proteins (g/day)	135.7± 59.9	168.8± 93.6	128.7± 59.5	145.2± 10.3	
Carbohydrates (g/day)	367.2± 187.7	370.0± 142.2	338.9± 126.8	660.6± 463.8	
Lipids (g/day)	102.4± 56.3	134.7± 84.6	124.9± 52.8	88.9± 17.8	

All variables are present as mean± standard deviation. *p*-value comparison of variables between position in the field (wing players and backcourt athletes). *$p < 0.05$.

and carbohydrate intake. Pivot's athletes have a higher protein and lipid intake compared to other positions.

According to our results, average body weight, height, and BMI of all athletes in the current study were normal or healthy weight but were higher than standard values for young athletes (Collaboration, 2017; Mascherini, Galanti, Massetti, Cala, & Modesti, 2019), and according to global age-standardised mean BMI of children and adolescents aged 5–19 years in 2016 was 18.6 kg/m^2 for females and 18.5 kg/m^2 for males (Collaboration, 2017). And consistent with

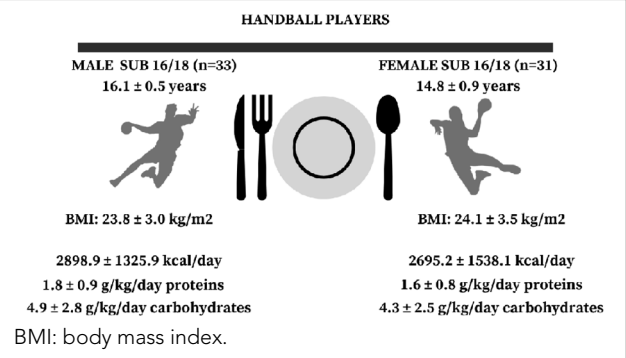

Figure 1. Mean values of energy (kcal/day), macronutrients (proteins and carbohydrates) per kg per day of young handball athletes between female and male.

physiological, there are differences between the sexes, since men are, in general, taller, heavier, have larger muscle mass, and are stronger than women (Michalsik & Aagaard, 2015).

Physical training in handball should be designed and performed to reflect the specific demands placed on male and female athletes, respectively. To the best of our knowledge, no previous study has examined the nutritional differences according to different sexes and positions in Portuguese athletes.

When comparing the ingestion of macronutrients between sex, the mean energy intake was significantly higher in males than in females (2,952.9± 1,315.8 kcal/day and 2,167.4± 1,185.0, respectively (p= 0.015)). The energy intake-adjusted to weight was 39.3± 19.3 kcal/kg/day for males and 34.8± 19.7 kcal/kg/day for females. According to other studies, handball players at the beginning of and during the sports season has been around 2,700–3,200 kcal/day and 3,100–3,600 kcal/day, respectively, for males and 1,800–2,400 kcal/day for women (Molina-Lopez et al., 2013). On the other hand, a study among 16 Brazilian female players had an energy intake of 1,883 per day (comparable with the 1,690 kcal per day found here), which was mentioned to be at least 220–440 kcal less than the recommended range (Hermassi et al., 2019).

The athlete's energy need will depend on the training and competition cycle, duration, frequency of matches, length of the season, training phase, and the number of players and substitutions. Energy balance, therefore, occurs when energy consumption is equal to total energy expenditure or the sum of the energy expended as the basal metabolic rate, the thermal effect of the food, the thermal effect of the activity (energy expended on planned physical activity), and thermogenesis of resting activity (Molina-Lopez et al., 2013).

The contribution of macronutrients (carbohydrates, proteins and lipids) in handball athletes is fundamental. The protein intake may be a priority in the diet of a handball player due to the difference in weight, height, fat percentage, and muscle mass according to different positions. According to recommendations from the American College of Sports Medicine (ACSM) and International Society of Sports Nutrition Position Stand (ISSN) organisations, the protein intake ranges from 1.2 to 2.0 g/kg/day (Thomas, Erdman, & Burke, 2016; Jager et al., 2017). In our study, the weight-adjusted protein intake found in females and males (1.6± 0.8 and 1.8± 0.9 g/kg/day, respectively), the male group's intake was near the upper recommendation limit (American Dietetic Association, Dietitians of Canada, & American College of Sports Medicine, 2009). And it is important to take into account that all of these intake values are according to food intake. This means that many of the incentives given to this population for supplementation have to be rethought and viewed individually if whether or not there is a need.

Regarding carbohydrate intake, young male athletes showed higher weight-adjusted ingestion, 4.3± 2.5 and 4.9± 2.8, respectively, being below the recommended for the studied sample: 6–10 g/kg/day (Thomas et al., 2016). According to different authors, male handball players reported ingesting an average of 4.1–4.8 g/kg/day, while female players consumed about 3.7–4.0 g/ kg/day (Molina-Lopez et al., 2013). The ACSM has estimated a range between 20% and 35% for fats total energy intake in athletes, and according to our study's data, women had a fat intake higher (37.3%) than men (33.5%). It exceeds the recommendations, while the fat intake by men is within the recommendations.

Therefore, these athletes might benefit from specific nutritional guidance to increase CHO ingestion and implement strategies to adjust protein and lipid intake.

Considering the game position, our study found that athletes in wing positions have a higher energy intake compared to the other positions. And according to macronutrients intake, wing athletes had a significantly higher protein intake (g/day) than other positions and carbohydrate and lipids intake (g/day).

Given the scarcity of information on dietary intake in athletes of different positions, it is not possible to relate these results with other works. Considering the demand of these athletes' work on the field and other informations about anthropometric measures, such as wing athletes are significantly smaller and have significantly lower body mass (Hermassi et al., 2019). Our study was in accordance with these results since female, and male athletes in this position have a lower BMI. This happens because the wings cover the largest field area and carry out most of the counterattacks, therefore they need lighter and faster bodies with the capacity for rapid changes of movement and agility (Hermassi et al., 2019).

Female goalkeepers are the heaviest of all players according to their position in the game (Hermassi et al., 2019), however, in the present study, the heaviest female players were the pivots. Considering that we only have the BMI value, we do not know which value corresponds to the percentage of fat mass or muscle mass. Pivots must catch the passes during an attack, and high defence players hinder them, therefore, high body height values can give them an advantage over those (Hermassi et al., 2019). In our study, the goalkeepers' male athletes had a higher energy intake and carbohydrate intake. Pivot's athletes have a higher protein and lipid intake compared to other positions.

Although macronutrient ingestion probably reflecting an adequate energy intake, several micronutrients were below the dietary reference intake, such as calcium and vitamin E in females and vitamin C and D in both sexes. Vitamins have also been widely studied to help athletes reduce stress damage, maintain a healthy immune system, and play a beneficial role in injury prevention and tissue repair in response to exercise (Walsh, 2019). These values were also found in other athletic groups, namely triathletes, runners, water polo players, and female junior and adolescents soccer players. Concerning vitamin D, that in our study in both sexes had an intake below dietary recommendation, is important in handball athletes due to its possible negative impact on bone health, immune function, inflammatory modulation, and muscle function and performance.

This study had some limitations, considering the time of evaluations, which did not permit the asessement of more parameters, such as the use of accelerometers to measure the physical activity, biochemical parameters, and body fat mass and skinfolds. Concerning the use of FFQ, although it has an acceptable validity, the interpretation of questions through young athletes was difficult, and the interpretation of the results should be made with caution. Nevertheless, this study allowed the collection of information regarding the young handball athletes' dietary intake.

CONCLUSIONS

In conclusion, this study is a big step in the future of handball because it allowed us to analyse young handball athlete's nutritional intake. According to the recommendations from food, most of the athletes reported a generally higher nutritional intake (protein intake was near to the upper recommendation limit; the carbohydrate intake was below and the fat intake higher) and a lower for some micronutrients. According to their positions in the game, energy intake is higher in wing female athletes and goalkeepers' male athletes. The female wing athletes have a higher significantly protein intake than other positions.

Considering these results, it seems plausible that specific nutritional training and education, especially with the involvement of experts in sports nutrition, would yield higher percentages of athletes fulfilling the recommendations according to their position and their expenditure in the game, since nutrition in these athletes may influence their future in the selection process and their professional life as handball athletes.

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