RBNE
Revista Brasileira de Nutrição Esportiva

DIETARY PATTERNS AND BODY COMPOSITION OF ADOLESCENT HANDBALL PLAYERS IN BRAZIL: A CHEMOMETRIC APPROACH

Claudio André Tortato de Morais[1], Gabriel de Bortoli Tibes da Luz[1]
Ana Claudia Lunelli Moro[1], Fernando Straparava Raia[2], Débora Fernandes Pinheiro[1,3]

ABSTRACT

This study assessed the body composition and dietary intake of 16 professional handball players from the Associação Caçadorense de Handball. Anthropometric data and dietary intake were analyzed. Statistical methods included a one-sample t-test and chemometric analyses, such as PCA and Pearson correlations. The athletes' caloric intake (2,192 kcal/day) met energy demands, but carbohydrate (245.90 g/day) and protein (120.09 g/day) intake exceeded recommendations. Water intake (1.67 L/day) was below the recommended 3.3 L/day, potentially affecting hydration. Deficiencies were found in calcium, magnesium, and vitamins D, B6, and E, while iron, zinc, and vitamin C were adequate. Fiber (35.38 g/day) and potassium (2.99 g/day) were insufficient. Skinfold analysis showed an average body fat percentage of 11.22%, considered healthy, but with visceral fat accumulation in the subscapular (12.25 mm) and abdominal (13.92 mm) regions. Suprailiac (10.50 mm) and thigh (15.67 mm) measurements suggested fat distribution patterns relevant to performance. Chemometric analyses revealed a negative correlation between BMI and protein intake (p = 0.018; R = -0.60) and positive correlations between fiber and zinc (p=0.016; R = 0.28), calcium and iron (p=0.03; R = 0.54), and calcium and magnesium (p=0.01; R = 0.65). Although caloric intake and body composition were adequate, micronutrient deficiencies and visceral fat accumulation highlight the need for dietary adjustments. Increasing water and fiber intake is crucial for optimizing health, performance, and recovery. This study provides valuable insights for sports nutrition and fitness professionals.

Key words: Nutrition. Athletic performance. Adolescence. Body composition. Anthropometry.

1 - Universidade Alto Vale do Rio do Peixe (UNIARP), Departamento de Nutrição, Caçador, Santa Catarina, Brasil.

RESUMO

Padrões alimentares e composição corporal de jogadores adolescentes de handebol no brasil: uma abordagem quimiométrica

Este estudo avaliou a composição corporal e a ingestão alimentar de 16 jogadores profissionais de handebol da Associação Caçadorense de Handebol. Dados antropométricos e a ingestão alimentar foram analisados. Teste t de uma amostra e análises quimiométricas, como PCA e correlações de Pearson. A ingestão calórica dos atletas (2.192 kcal/dia) atendeu às demandas energéticas, mas a ingestão de carboidratos (245,90 g/dia) e proteínas (120,09 g/dia) superou as recomendações. A ingestão de água (1,67 L/dia) ficou abaixo dos 3,3 L/dia recomendados, o que pode afetar a hidratação. Deficiências foram encontradas em cálcio, magnésio e nas vitaminas D, B6 e E, enquanto o ferro, o zinco e a vitamina C estavam adequados. A ingestão de fibra (35,38 g/dia) e potássio (2,99 g/dia) foi insuficiente. A análise das dobras cutâneas mostrou um percentual médio de gordura corporal de 11,22%, considerado saudável, mas com acúmulo de gordura visceral nas regiões subescapular (12,25 mm) e abdominal (13,92 mm). As medições suprailiaca (10,50 mm) e da coxa (15,67 mm) sugeriram padrões de distribuição de gordura relevantes para o desempenho. As análises quimiométricas revelaram uma correlação negativa entre o IMC e a ingestão de proteínas (p=0,018; R = -0,60) e correlações positivas entre fibra e zinco (p=0,016; R = 0,28), cálcio e ferro (p=0,03; R = 0,54), e cálcio e magnésio (p=0,01; R = 0,65). Embora a ingestão calórica e a composição corporal estivessem adequadas, deficiências de micronutrientes e o acúmulo de gordura visceral destacam a necessidade de ajustes dietéticos. Aumentar a ingestão de água e fibras é crucial para otimizar a saúde, o desempenho e a recuperação.

Palavras-chave: Nutrição. Desempenho atlético. Adolescência. Composição corporal. Antropometria.

INTRODUCTION

Handball is one of the most popular team sports globally. Played in two 30-minute halves with a 15-minute interval, it is a high-intensity game characterized by constant changes in direction, repeated accelerations, physical contact between players, jumps, and throws, with no allowance for passive play (Ermidis et al., 2021).

For decades, it ranked as the second most followed sport worldwide. Played on all continents, handball has its own World Cup and is an official Olympic competition (Bilge, 2012).

Notably, performance in handball is influenced by factors such as sexual, skeletal, and somatic maturation, which are critical components for assessing growth spurts. The timing and duration of these growth spurts can vary significantly among individuals (Aouichaoui et al., 2024).

As a complex, multifactorial, and highly demanding sport, handball requires players to maintain optimal physical conditioning to achieve peak performance. One of the primary aspects influencing improved performance is dietary and nutritional planning, as it ensures the necessary intake to meet energy and nutrient demands during sports practice (Amawi et al., 2024; Martín-Rodríguez et al., 2024; García-Sánchez et al., 2023).

Anthropometry and body composition also play essential roles in gameplay, as the specific demands of player positions require different body dimensions and high levels of strength and power to withstand multiple physical contacts and execute intense bursts of activity (Petri et al., 2024).

Adolescent athletes experience a period of rapid growth and development, making nutritional choices particularly important. Adequate nutrient intake during this phase can influence neurodevelopment, bone mineral density, and the risk of chronic diseases (Sale, Elliott-Sale, 2019).

Adhering to population-based dietary guidelines and sports-specific recommendations provides long-term health benefits and athletic advantages (Hulland, Trakman, Alcock, 2024).

Training and nutrition are closely linked, as optimal adaptation to the demands of repeated training sessions often requires a diet adequate in both quantity and type of nutrients (Kaufman et al., 2023).

During intensive training periods, energy and macronutrient recommendations, particularly for carbohydrates and proteins, must be met to maintain body mass, replenish muscle glycogen stores, and support tissue repair and regeneration (Martín-Rodríguez et al., 2024).

Fat intake should suffice to meet essential fatty acid needs, and micronutrient intake should not be neglected, as exercise increases micronutrient requirements (Ghazzawi et al., 2023).

Proper nutrition is crucial for young athletes to achieve adequate growth and optimal sports performance (Bosco et al., 2024).

Young athletes must learn which foods provide energy, when to eat certain foods, how to eat during an event, and when and what to eat for recovery after activity (Capra et al., 2024) Amawi et al., 2024; Desbrow, 2021).

A balanced diet containing sufficient macronutrients and micronutrients is essential to meet energy demands for growth and activity (Ghazzawi et al., 2023).

Equally important, adequate fluid intake plays a vital role in maintaining hydration, which supports not only overall growth but also optimal athletic performance (Judge et al., 2021).

Sports nutrition plays a vital role in enhancing athletic performance by minimizing fatigue, reducing the risk of illness and injury, and optimizing training and recovery (Turnagöl et al., 2021; Papadopoulou et al., 2022). Maintaining energy balance is crucial, as deficits can impair growth, delay puberty, and increase susceptibility to fatigue and injuries, while excess intake may lead to overweight and obesity (Purcell, 2013).

Given the growing importance of proper nutrition for handball teams, addressing athletes' macro- and micronutrient needs has become essential.

Junior athletes, in particular, are in a critical phase of development, where nutrition and physical assessment influence not only performance but also long-term health.

Monitoring these factors through tailored follow-up plans helps identify deficiencies, optimize performance, and reduce injury risks.

This study aims to support players and youth sports programs by promoting best practices in physical assessment and nutritional monitoring, strengthening the local sports community, and fostering a culture of well-being.

Beyond practical applications, the study also contributes to sports nutrition research, offering insights to professionals and advancing scientific knowledge. Specifically, it aimed to: (i) evaluate macro- and micronutrient intake, (ii) analyze body composition, (iii) assess hydration levels, and (iv) examine sports supplement use among professional handball players.

MATERIALS AND METHODS

Study Type

This study was a prospective, qualitative investigation conducted in two phases: the first consisted of anthropometric evaluation, and the second focused on the dietary assessment of athletes. The study took place between June and November 2024, involving junior athletes from the handball team aged 15 to 18 years.

Research Location

The research was conducted at the Associação Caçadorense de Handebol, located in Caçador, Santa Catarina, Brazil. Sixteen players from the professional handball team were evaluated. The team competes in Brazil's first-division league, classified as Series A.

Inclusion and Exclusion Criteria

All active players from the handball team were invited to participate in the study. Inclusion criteria required participants to sign the Informed Consent Form (ICF) and be male athletes. Exclusion criteria included refusal to sign the ICF, players not actively participating in the team, athletes who did not complete both phases of the study, and individuals outside the age range of junior athletes.

Dietary Assessment

Dietary intake was assessed using the Habitual Food Day (HFD) questionnaire, completed by the evaluators. The HFD quantified the food and beverages commonly consumed on typical days. Macro and micronutrient contents were analyzed using the WebDiet® dietary software.

Anthropometric Assessment

Participants underwent anthropometric evaluations, including measurements of weight, height, and skinfold thickness (thoracic, mid-axillary, triceps, subscapular, abdominal, suprailiac, and thigh). Weight was measured with a digital Omron® scale, height with a stadiometer, and skinfolds with a Sanny® caliper. Body Mass Index (BMI) was calculated using weight and height measurements and interpreted according to the World Health Organization (WHO) reference values (2012). Body fat percentage was determined using the 7-site skinfold method by Jackson, Pollock, and Ward (1978).

Ethical Considerations

The study adhered to the guidelines of the UNIARP Ethics and Research Committee (CEP) and was approved under protocol no. 7.111.937/2024.

Statistical Analysis

Results were expressed as mean ± standard deviation. Data normality was tested using the Shapiro-Wilk or Kolmogorov-Smirnov tests, depending on the distribution. A one-sample t-test was used to compare dietary intake with Recommended Dietary Allowances (RDA), considering $p<0.05$ as significant. Chemometric analyses included principal component analysis (PCA) and heat maps to group variables related to body composition and dietary intake. Pearson correlation tests were performed for parametric data. Statistical analysis and figure creation were conducted using GraphPad Prism software, version 9.5.

RESULTS AND DISCUSSION

Anthropometric Assessment

The sample comprised sixteen (n=16) adolescents with an average age of 14.75 ±0.75 years, with an average weight of 69.88 ±13.99 kg, height of 1.73 ±7.13 m, and BMI of 23.12 ±3.51 kg/m^2, being considered appropriate for their age. Their body composition is detailed in Table 1.

The average body fat percentage, estimated at 11.22 ±5.71% via skinfold measurements, varied due to genetics, physical activity, and diet (Silventoinen et al., 2023).

Among the measured skinfolds, the subscapular (12.25 ±6.03 mm) and abdominal (13.92 ±8.73 mm) stood out, as fat accumulation in these areas is linked to increased metabolic risk, including insulin resistance and cardiovascular diseases (González-Torres et al., 2023). The suprailiac skinfold (10.50 ±5.13 mm) further reinforced this risk assessment.

Other measurements included thoracic (7.83 ±5.59 mm), medial axillary (10.0 ±6.69 mm), tricipital (11.0 ±7.62 mm), and thigh (15.67 ±9.23 mm) skinfolds (Table 1).

Given their practicality, skinfold assessments help monitor body composition changes and guide interventions in diet and physical activity. While body fat percentage appeared within expected ranges, the distribution suggests a potential metabolic risk, emphasizing the need for targeted strategies.

Table 1 - Sample Characterization, Anthropometric, and Body Composition Assessment

Variables	Mean ± SD
Age (years)	14.75 ± 0.75
Weight (kg)	69.88 ± 13.99
Height (m)	1.73 ± 7.13
BMI (kg/m²)	23.12 ± 3.51
Subscapular Skinfold (mm)	12.25 ± 6.03
Suprailiac Skinfold (mm)	10.50 ± 5.13
Abdominal Skinfold (mm)	13.92 ± 8.73
Thoracic Skinfold (mm)	7.83 ± 5.59
Medial Axillary Skinfold (mm)	10.0 ± 6.69
Tricipital Skinfold (mm)	11.0 ± 7.62
Thigh Skinfold (mm)	15.67 ± 9.23
% Body Fat	11.22 ± 5.71

Notes: SD: Standard deviation; BMI: Body Mass Index (Índice de Massa Corporal); SF: Skinfold; %: Percentage.

Dietary Evaluation of Macronutrient Intake

Based on the dietary analysis, the caloric intake data (2192 ± 705.49 kcal/day) fall within a range that can support the energy needs of adolescents, considering an average level of physical activity. However, carbohydrate (245.90 g/day) and protein (120.09 g/day) intake exceed the recommended daily allowances (RDA), which can be beneficial in high-performance physical contexts but may raise concerns about dietary balance (Soliman et al., 2022).

The macronutrient proportions (50% carbohydrates, 20% proteins, and 30% lipids) suggest an eating pattern that may not be ideal for all adolescents. Water intake (1.67 liters/day) showed a significant difference ($p<0.0001$) compared to the RDA recommendation of 3.3 liters, which could impact hydration and physical performance.

This underscores the need to promote greater awareness of proper hydration, as insufficient water intake may lead to hydroelectrolytic imbalances and compromised homeostasis, potentially resulting in dehydration and reduced athletic performance (Judge et al., 2021); Armstrong, 2021).

The dietary intake results, analyzed through food intake surveys for macronutrients, are presented in Table 2 below.

Table 2 - Daily Dietary Intakes Assessment.

Variables	Mean ± SD	RDA	p
Caloric intake (kcal/day)	2192 ± 705.49	-	-
Carbohydrates (g/day)	245.90 ± 90.89	130	0.001
Proteins (g/day)	120.09 ± 72.97	52	0.008
Lipids (g/day)	84.18 ± 46.63	ND	-
Carbohydrates (%)	43.48 ± 10.89	45-65	0.0624
Proteins (%)	22.68 ± 6.36	10-30	0.1720
Lipids (%)	33.85 ± 11.21	25-35	0.2591
Trans fats (g/day)	4.78 ± 10.53	ND	-
Monounsaturated fatty acids (g/day)	29.03 ± 17.90	ND	-
Saturated fatty acids (g/day)	31.56 ± 17.84	ND	-
Fiber (g/day)	35.38 ± 18.09	38	0.6251
Cholesterol (g/day)	621.52 ± 589.19	ND	-
Water (liters/day)	1.67 ± 0.86	3.3	< 0.0001

Notes: For calculating the significance of p in carbohydrates, 50% was used; for proteins, 20%; for lipids, 30%. g: gram; %: percentage; RDA: Recommended Dietary Allowance; p< 0.05, on a one-sample t-test.

Dietary Evaluation of Micronutrient Intake

The dietary assessment conducted in this study revealed the daily micronutrient intake of the athletes (Table 3).

The findings indicate that the athletes' diet was generally inadequate and insufficient for most macronutrients when compared to the recommendations of the RDA.

The 24-hour dietary recall highlighted a diet high in ultra-processed foods and saturated fats, with a low intake of fruits, vegetables, and legumes. Additionally, as shown in Table 2, there was a notably low water intake.

Regarding micronutrient intake, several nutrients were significantly below the recommended levels: calcium at 548.08 ± 296.07 mg/day (p<0.0001); magnesium at 270.58 ± 104.58 mg/day (p=0.0007); vitamin A at 527.64 ± 505.74 µg/day (p=0.0270); vitamin B6 at 0.58 ± 0.33 mg/day (p<0.0001); vitamin D at 1.13 ± 1.52 mg/day (p<0.0001); and vitamin E at 6.26 ± 5.84 mg/day. Conversely, some micronutrients were significantly above the recommended levels, including iron at 16.32 ± 6.17 mg/day (p=0.0124), copper at 2.09 ± 1.03 mg/day (p=0.002), and zinc at 18.35 ± 8.53 mg/day (p=0.0124) (Table 3).

Table 3 - Micronutrient Intake Assessment.

Micronutrient	Mean ± SD	RDA	p
Calcium (mg/day)	548.08 ± 296.07	1,300	< 0.0001
Iron (mg/day)	16.32 ± 6.17	11	0.0124
Potassium (mg/day)	2.99 ± 1.26	4.7	0.0007
Sodium (mg/day)	1.32 ± 0.746	1.5	0.4353
Copper (mg/day)	2.09 ± 1.03	0.89	0.002
Phosphorus (mg/day)	1469.82 ± 617.63	1,250	0.2433
Magnesium (mg/day)	270.58 ± 104.58	410	0.0007
Selenium (µg/day)	55.16 ± 65.65	55	0.9935
Zinc (mg/day)	18.35 ± 8.53	11	0.0124
Vitamin A (µg/day)	527.64 ± 505.74	900	0.0270
Vitamin B1 (thiamine) (mg/day)	1.20 ± 0.47	1.2	> 0.999
Vitamin B2 (riboflavin) (mg/day)	1.03 ± 0.69	1.3	0.1966
Vitamin B3 (niacin) (mg/day)	33.20 ± 43.16	16	0.1948
Vitamin B6 (pyridoxine) (mg/day)	0.58 ± 0.33	1.3	< 0.0001
Vitamin B9 (folate) (µg/day)	534.63 ± 270.06	400	0.1121
Vitamin B12 (µg/day)	2.79 ± 4.03	2.4	0.7428
Vitamin C (mg/day)	150.63 ± 212.59	75	0.2435
Vitamin D (mg/day)	1.13 ± 1.52	15	< 0.0001
Vitamin E (mg/day)	6.26 ± 5.84	15	0.0003

Notes: Data obtained from the Dietary Reference Intake for ages 14-18 recommended by the WHO (World Health Organization). mg: milligrams; day: daily; µg: micrograms; SD: standard deviation. p is significant when < 0.05.

The results highlight several concerning nutritional deficiencies among the athletes assessed. The intake of calcium (548.08 mg/day) and magnesium (270.58 mg/day) was significantly below recommendations, which could impair bone health, especially during a critical phase for skeletal development. The low intake of vitamin D (1.13 mg/day) further exacerbates this situation, considering its importance for calcium absorption and maintaining bone density.

Although the intake of iron (16.32 mg/day) and zinc (18.35 mg/day) met or exceeded the recommended levels, the intake of vitamin A (527.64 µg/day) fell short of the ideal.

Additionally, significant deficiencies in vitamins B6 and E emphasize concerns about a possibly inadequate dietary pattern in terms of diversity and balance. Although fiber intake (35.38 g/day) approached the RDA.

Micronutrients are vital for health and athletic performance, particularly in adolescents. Calcium supports bone formation and muscle contraction, with deficiencies increasing fracture risk under intense physical stress (Ciosek et al., 2021).

Magnesium, essential for energy production and muscle function, prevents fatigue, cramps, and cardiovascular issues (Fiorentini et al., 2021).

Vitamin D enhances calcium and phosphorus absorption, crucial for bone and muscle health, while its deficiency heightens injury risk (Mendes, Botelho, Ribeiro, 2022). Vitamin B6 aids protein metabolism and neurotransmitter synthesis, influencing recovery and cognitive function (Tardy et al., 2020).

Vitamin E, a key antioxidant, protects against oxidative stress, reducing inflammation and muscle injuries (Mâncio et al., 2017).

Fiber supports digestive health, glycemic regulation, and satiety, preventing gastrointestinal issues that can impair energy levels during exercise (Hadžić et al., 2023).

Proper nutrition underpins performance and recovery, emphasizing the need for a balanced diet tailored to individual needs (Amawi et al., 2024).

Although many athletes rely on supplements, only 16% (n=2) of participants in this study used creatine or whey protein. Prioritizing dietary micronutrients remains essential for muscle function, bone health, and recovery, preventing deficiencies and optimizing performance.

Chemometric analyses

Principal Component Analysis (PCA) was conducted to explore the data based on their similarities and differences. For the PCA, the variables were considered dependent, and the data used are organized in Pearson correlation tables. These tables provide a direct relationship between the study variables, allowing the identification of the most relevant variables for group separation (PC1 and PC2).

The first two principal components (PC1 and PC2) together explain 52.94% of the data variance, with PC1 accounting for 33.04% and PC2 for 19.90%. The caloric intake per day (kcal) of the athletes is located near the central axis, suggesting that this variable is considered neutral on both axes.

Several data clusters were analyzed, such as potassium (K), calcium (Ca), vitamin B1 (VitB1), vitamin B9 (VitB9), and protein percentage (PTN %), showing positive correlations between these variables. However, it is noted that the abdominal skinfold (DAbd) and medial axillary skinfold (DAxi) variables have negative correlations with protein intake (PTN %), meaning that lower protein intake in the diet is associated with higher values of these skinfolds.

RBNE
Revista Brasileira de Nutrição Esportiva

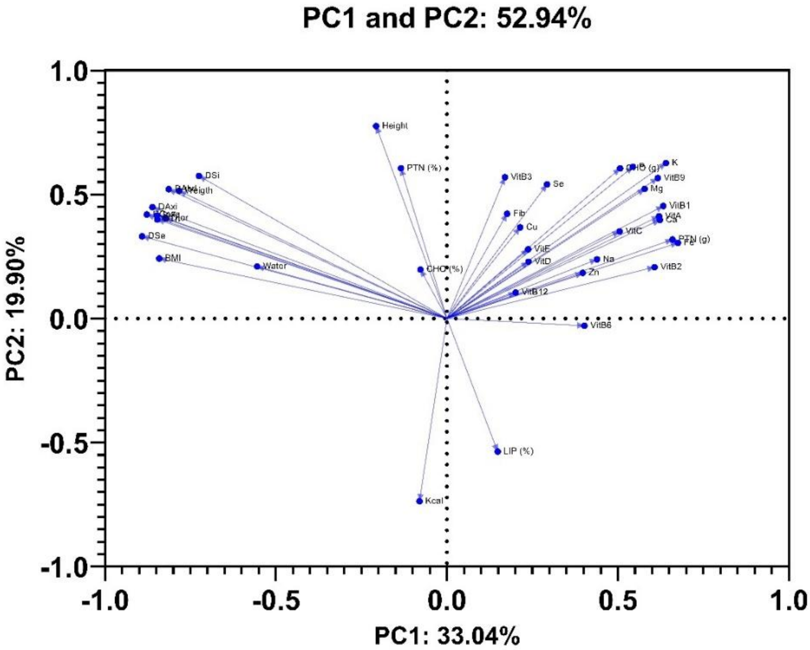

Figure 1 - Principal Component Analysis (PCA) of the study variables.

Notes: BMI: Body Mass Index; DSe: Subscapular Skinfold; DSi: Suprailiac Skinfold; DAbd: Abdominal Skinfold; DTor: Thoracic Skinfold; DAxi: Medial Axillary Skinfold; DTrip: Tricipital Skinfold; DCoxa: Thigh Skinfold; %F: Body Fat Percentage; Kcal: Kilocalories ingested/day; CHO: Carbohydrate; PTN: Protein; LIP: Lipids; g: gram; %: percentage; Ca: Calcium, Fe: Iron; K: Potassium; Na: Sodium; Cu: Copper; P: Phosphorus; Mg: Magnesium; Se: Selenium; Zn: Zinc; Vit: Vitamin.

Another significant result from the anthropometric and dietary evaluation was the relationship between the suprailiac skinfold (DSi), DAbd, DAxi, subscapular skinfold (DSe), body fat percentage (%G), and BMI with lipid (LIP %) and protein (PTN %) intake in the diet. Specifically, the lower the values of these skinfolds, overall body fat percentage, and BMI, the lower the daily lipid intake and the higher the protein intake. As shown in Figure 1 below.

To corroborate the data, a heatmap was created (Figure 2), based on the clustering analysis of the matrices, representing the concentrations of the 38 variables in the study. In this map, the colors range from blue (representing lower values) to red (representing higher values), allowing for the identification of significant differences in body composition and dietary assessment of the athletes.

The main correlations observed include an inverse association between the athletes' weight and the size of the skinfolds - DSe, DSi, DAbd, DTor, DAxi, DCoxa - as well as BMI, with statistical significance ($p<0.000$). In other words, athletes with lower weight had smaller skinfold measurements and BMI.

Additionally, a negative correlation was found between BMI and protein intake (g) ($p=0.018$; $R = -0.60$), indicating that athletes with a lower BMI tend to consume less protein. A negative correlation was also observed between fiber intake and zinc consumption ($p=0.016$; $R = -0.28$), suggesting that an increase in fiber intake is associated with lower zinc intake.

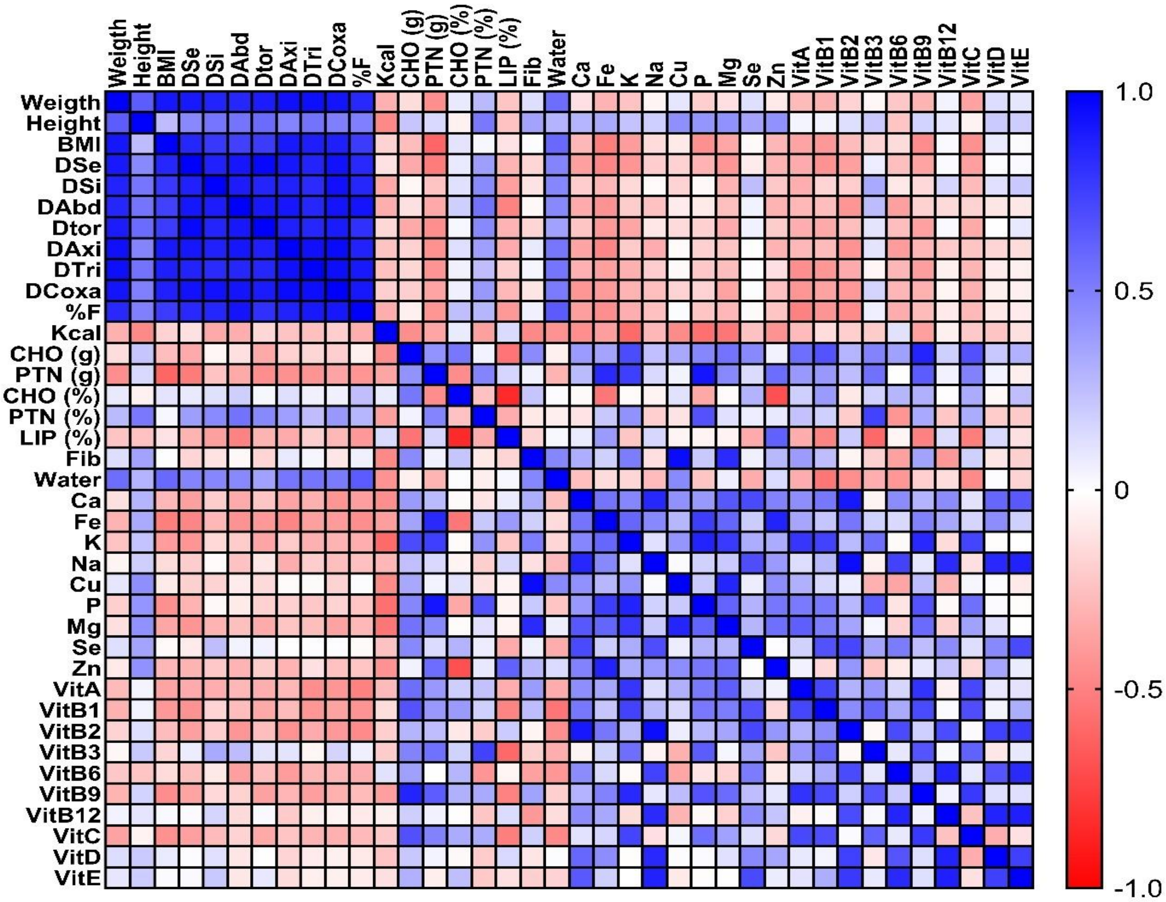

Figure 2 - Heatmap of the study variables.
Notes: BMI: Body Mass Index; DSe: Subscapular Skinfold; DSi: Suprailiac Skinfold; DAbd: Abdominal Skinfold; DTor: Thoracic Skinfold; DAxi: Medial Axillary Skinfold; DTrip: Tricipital Skinfold; DCoxa: Thigh Skinfold; %F: Body Fat Percentage; Kcal: Kilocalories ingested/day; CHO: Carbohydrate; PTN: Protein; LIP: Lipids; g: gram; %: percentage; Ca: Calcium; Fe: Iron; K: Potassium; Na: Sodium; Cu: Copper; P: Phosphorus; Mg: Magnesium; Se: Selenium; Zn: Zinc; Vit: Vitamin.

Among the positive correlations, there was a significant association between vitamin B3 and protein intake, both in grams and percentage (p=0.03; R = 0.56 and p=0.00; R =0.74, respectively), as well as a positive correlation between calcium and iron (p=0.03; R=0.54), and between calcium and magnesium (p=0.01; R=0.65). These findings point to specific patterns in the athletes' nutritional and body composition, providing detailed information about their dietary and anthropometric correlations.

The results are particularly relevant for team sport athletes, as increasing nutritional knowledge can significantly improve eating habits and, consequently, performance. Therefore, nutrition education interventions are crucial for optimizing performance in team sports.

Onell et al., (2023) studied 1,040 handball players with an average age of 16.6 years and found that their dietary intake was nutritionally adequate.

Similarly, (Arnaoutis et al., 2024) assessed the nutritional status of 39 players, finding an average body fat percentage of 16.7 ± 3.8% and a daily energy intake of 2,606.6 ± 756 kcal. The intake of carbohydrates, proteins, and fats was 243.85 ± 107.79 g, 131.59 ± 53.28 g, and 117.65 ± 40.52 g, respectively.

Nutrition plays a key role in optimizing athletic performance. Proper dietary intake is directly related to body function and composition. Nutritional strategies, such as timing and quantity of food and supplements, help athletes stay healthy, prevent injuries, and improve performance. For indoor team sports like handball, carbohydrates are the primary energy source, with recommendations of 6 to 10 g/kg of body weight for 1 to 3-hour training sessions. Protein intake is crucial for muscle recovery, with recommendations ranging from 1.2 to 2 g/kg per day. Excessive fat intake may negatively affect body composition and gastric emptying, so it should be limited to 25 to 30% of total daily energy intake.

However, our study has some limitations. Although we analyzed all athletes from the handball team in the city, the limited sample size may not fully represent the body composition and dietary patterns of Brazilian athletes in general. It is important to note that handball is not a widely practiced sport in Brazil, with a relatively low number of enthusiasts.

However, our findings reveal consistent patterns within the team, which can serve as a foundation for future studies with larger samples, providing significant insights into the relationship between diet, body composition, and performance in handball.

CONCLUSION

The research highlights the importance of balanced nutrition for young athletes, emphasizing how diet can impact handball performance.

The study underscores the urgent need for nutritional interventions to address micronutrient deficiencies, particularly calcium and vitamin D, which are critical for bone health. It also stresses the need to raise awareness about hydration and adequate fluid intake, as young athletes often fail to meet recommendations.

It is recommended that clubs and coaches integrate personalized nutritional guidance into training programs, promoting diets that support growth and athletic performance.

Adopting proper nutritional strategies can not only optimize athletic performance but also ensure long-term health, preventing potential injuries and health issues related to poor nutrition.

Continuous monitoring of athletes' body composition and diet is essential to make adjustments that meet each player's specific needs, fostering sustainable development in sports.

REFERENCES

1-Amawi, A.; Alkasasbeh, W.; Jaradat, M.; Almasri, A.; Alobaidi, S.; Hammad, A. A.; Bishtawi, T.; Fataftah, B.; Turk, N.; Saoud, H. A.; Jarrar, A.; Ghazzawi, H. Athletes' nutritional demands: a narrative review of nutritional requirements. Frontiers in Nutrition. Vol. 10. 2024. p. 1331854.

2-Aouichaoui, C.; Krichen, S.; Tounsi, M.; Ammar, A.; Tabka, O.; Chatti, S.; Zaouali, M.; Zouch, M.; Trabelsi, Y. Reference Values of Physical Performance in Handball Players Aged 13–19 Years: Taking into Account Their Biological Maturity. Clinics and Practice. Vol. 14. Num. 1. 2024. p. 305-326.

3-Armstrong, L. E. Rehydration during Endurance Exercise: Challenges, Research, Options, Methods. Nutrients. Vol. 13. Num. 3. 2021. p. 887.

4-Arnaoutis, G.; Alepoudea, M.; Tambalis, K. D.; Sidossis, L. S. Dietary Intake, Body Composition, and Nutritional Knowledge of Elite Handball Players. Nutrients. Vol. 16. Num. 16. 2024. p. 2773.

5-Bilge, M. Game Analysis of Olympic, World and European Championships in Men's Handball. Journal of Human Kinetics. Vol. 35. 2012. p. 109-118.

6-Bosco, P.D.; Silva, C.A.; Moro, A.C.L.; Adami, E.R.; Vanz Borges, C.; Pinheiro, D.F. Aspectos alimentares e nutricionais das futebolistas profissionais de time feminino do município de Caçador-SC. Revista Brasileira de Nutriçao Esportiva. Vol. 18. Num. 111. 2024. p. 419-431.

7-Capra, M.E.; Stanyevic, B.; Giudice, A.; Monopoli, D.; Decarolis, N.M.; Esposito, S.; Biasucci, G. Nutrition for Children and Adolescents Who Practice Sport: A Narrative Review. Nutrients. Vol. 16. Num. 16. 2024. p. 2803.

8-Ciosek, Ż.; Kot, K.; Kosik-Bogacka, D.; Łanocha-Arendarczyk, N.; Rotter, I. The Effects of Calcium, Magnesium, Phosphorus, Fluoride, and Lead on Bone Tissue. Biomolecules. Vol. 11. Num. 4. 2021. p. 506.

9-Desbrow, B. Youth Athlete Development and Nutrition. Sports Medicine. Vol. 51. n. Suppl 1. 2021. p. 3-12.

10-Ermidis, G.; Ellegard, R.C.; Rago, V.; Randers, M.B.; Krustrup, P.; Larsen, M.N. Exercise Intensity and Technical Involvement in U9 Team Handball: Effect of Game Format. International Journal of Environmental Research and Public Health. Vol. 18. Num. 11. 2021. 2021. p. 5663.

11-Fiorentini, D.; Cappadone, C.; Farruggia, G.; Prata, C. Magnesium: Biochemistry, Nutrition, Detection, and Social Impact of Diseases Linked to Its Deficiency. Nutrients. Vol. 13. Num. 4. 2021. p. 1136.

12-García-Sánchez, C.; Navarro, R. M.; Karcher, C.; De La Rubia, A. Physical Demands during Official Competitions in Elite Handball: A Systematic Review. International Journal of Environmental Research and Public Health. Vol. 20. Num. 4. 2023. p. 3353.

13-Ghazzawi, H.A.; Hussain, M.A.; Raziq, K.M.; Alsendi, K.K.; Alaamer, R.O.; Jaradat, M.; Alobaidi, S.; Al Aqili, R.; Trabelsi, K.; Jahrami, H. Exploring the Relationship between Micronutrients and Athletic Performance: A Comprehensive Scientific Systematic Review of the Literature in Sports Medicine. Sports. Vol. 11. Num. 6. 2023. p. 109.

14-González-Torres, S.; Anaya-Esparza, L.M.; Trigueros Del Valle, G.F.; Rivera-León, E.A.; Villagrán, Z.; Sánchez-Enríquez, S. Skinfold Thickness as a Cardiometabolic Risk Predictor in Sedentary and Active Adult Populations. Journal of Personalized Medicine. Vol. 13. Num. 9. 2023. p. 1326.

15-Hadžić, E.; Starcevic, A.; Rupčić, T.; Zucko, J.; Čvrljak, T.; Renko, I.; Knjaz, D.; Novak, D. Effects of Soluble Dietary Fibre on Exercise Performance and Perception of Fatigue in Young Basketball Players. Food Technology and Biotechnology. Vol. 61. Num. 3. 2023. p. 389-401.

16-Hulland, S.C.; Trakman, G.L.; Alcock, R.D. Adolescent Athletes Have Better General than Sports Nutrition Knowledge and Lack Awareness of Supplement Recommendations: A Systematic Literature Review. The British Journal of Nutrition. Vol. 131. Num. 8. 2024. p. 1362-1376.

17-Judge, L.W.; Bellar, D.M.; Popp, J.K.; Craig, B.W.; Schoeff, M.A.; Hoover, D.L.; Fox, B.; Kistler, B.M.; Al-Nawaiseh, A.M. Hydration to Maximize Performance and Recovery: Knowledge, Attitudes, and Behaviors Among Collegiate Track and Field Throwers. Journal of Human Kinetics. Vol. 79. 2021. p. 111-122.

18-Kaufman, M.; Nguyen, C.; Shetty, M.; Oppezzo, M.; Barrack, M.; Fredericson, M. Popular Dietary Trends' Impact on Athletic Performance: A Critical Analysis Review. Nutrients. Vol. 15. Num. 16. 2023. p. 3511.

19-Mâncio, R.D.; Hermes, T. De A.; Macedo, A.B.; Mizobuti, D.S.; Valduga, A.H.; Rupcic, I.F.; Minatel, E. Vitamin E treatment decreases muscle injury in mdx mice. Nutrition. Vol. 43–44. 2017. p. 39-46.

20-Martín-Rodríguez, A.; Belinchón-Demiguel, P.; Rubio-Zarapuz, A.; Tornero-Aguilera, J. F.; Martínez-Guardado, I.; Villanueva-Tobaldo, C. V.; Clemente-Suárez, V. J. Advances in Understanding the Interplay between Dietary Practices, Body Composition, and Sports Performance in Athletes. Nutrients. Vol. 16. Num. 4. 2024. p. 571.

21-Mendes, M.M.; Botelho, P.B.; Ribeiro, H. Vitamin D and musculoskeletal health: outstanding aspects to be considered in the light of current evidence. Endocrine Connections. Vol. 11. Num. 10. 2022. p. e210596.

22-Papadopoulou, S.K.; Mantzorou, M.; Kondyli-Sarika, F.; Alexandropoulou, I.; Papathanasiou, J.; Voulgaridou, G.; Nikolaidis, P. T. The Key Role of Nutritional Elements on Sport Rehabilitation and the Effects of Nutrients Intake. Sports. Vol. 10. Num. 6. 2022. p. 84.

23-Petri, C.; Campa, F.; Holway, F.; Pengue, L.; Arrones, L. S. ISAK-Based Anthropometric Standards for Elite Male and Female Soccer Players. Sports. Vol. 12. Num. 3. 2024. p. 69.

24-Purcell, L.K. Sport nutrition for young athletes. Paediatrics & Child Health. Vol. 18. Num. 4. 2013. p. 200-202.

25-Sale, C.; Elliott-Sale, K.J. Nutrition and Athlete Bone Health. Sports Medicine (Auckland, N.z.).Vol. 49. Num. Suppl 2. 2019. p. 139-151.

26-Silventoinen, K.; Maia, J.; Li, W.; Sund, R.; Gouveia, É.R.; Antunes, A.; Marques, G.; Thomis, M.; Jelenkovic, A.; Kaprio, J.; Freitas, D. Genetic Regulation of Body Size and Morphology in Children: A Twin Study of 22 Anthropometric Traits. International Journal of Obesity. Vol. 47. Num. 3. 2023. p. 181-189.

27-Soliman, A.T.; Alaaraj, N.; Noor Hamed; Alyafei, F.; Ahmed, S.; Shaat, M.; Itani, M.; Elalaily, R.; Soliman, N. Review Nutritional Interventions during Adolescence and Their Possible Effects. Acta Bio-Medica: Atenei Parmensis. Vol. 93. Num. 1. 2022. p. e2022087.

28-Tardy, A.-L.; Pouteau, E.; Marquez, D.; Yilmaz, C.; Scholey, A. Vitamins and Minerals for Energy, Fatigue and Cognition: A Narrative Review of the Biochemical and Clinical Evidence. Nutrients. Vol. 12. Num. 1. 2020. p. 228.

29-Turnagöl, H.H.; Koşar, Ş.N.; Güzel, Y.; Aktitiz, S.; Atakan, M. M. Nutritional Considerations for Injury Prevention and Recovery in Combat Sports. Nutrients. Vol. 14. Num. 1. 2021. p. 531.

2 - Universidade Alto Vale do Rio do Peixe (UNIARP), Programa de Pós-Graduação em Desenvolvimento e Sociedade, Caçador, Santa Catarina, Brasil.
3 - Universidade Federal do Paraná (UFPR), Programa de Pós-Graduação em Engenharia de Alimentos (PPGEAL), Curitiba, Paraná, Brasil.

Corresponding author:
Débora Fernandes Pinheiro.
debora.fernandes@uniarp.edu.br
Departamento de Nutrição.
Universidade Alto Vale do Rio do Peixe,
Caçador, Santa Catarina, Brasil.
CEP: 89500-199.

Recebido para publicação em 26/03/2025
Aceito em 12/06/2025