

# Comparison of athlete diet index and body composition between professional and non-professional athletes: a comparative cross-sectional study

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## ABSTRACT

**Background:** This study aimed to compare the Athlete Diet Index (ADI) and body composition between professional and nonprofessional athletes to better understand how differences in training and nutrition impact athletic performance and health.

**Method:** A comparative cross-sectional design was used to analyze 183 athletes (99 professional, 84 nonprofessional) from various sports disciplines in Tehran. Data were collected on body composition parameters, including fat mass (FM) and fat free mass (FFM) using bioelectrical impedance analysis (BIA) and the ADI, a validated tool for assessing diet quality.

**Results:** The results revealed that professional athletes had significantly lower FM percentages ( $16.2\% \pm 7.1\%$ ) and higher FFM percentages ( $80.8\% \pm 6.8\%$ ) compared to their nonprofessional counterparts (FM  $18.8\% \pm 9.9\%$ , FFM  $78.0\% \pm 9.6\%$ ). Additionally, professional athletes exhibited higher ADI scores, indicating better adherence to sports nutrition guidelines.

**Conclusions:** These findings highlight the benefits of structured training and personalized nutrition in achieving favorable body composition. This study underscores the importance of personalized nutrition strategies for optimizing athletic health and performance, particularly for nonprofessional athletes who may not have access to professional dietary guidance. Further research is needed to explore the long-term effects of dietary and training interventions on body composition and athletic performance across various athlete populations.

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## KEYWORDS

Athlete diet index; professional athletes; nonprofessional athletes; fat mass; fat free mass; sports nutrition

## 1. Introduction

In sports nutrition, a well-balanced diet and favorable body composition are key indicators of athletic performance, recovery, and long-term health [1,2]. Growing evidence has demonstrated that a properly balanced diet is associated with reduced fat mass (FM), increased muscle mass, and improved body composition [3–6]. Body composition is a reliable marker of physical preparedness and overall health in athletes and includes parameters such as fat, lean, and fat free mass (FFM) [7,8]. Numerous studies have shown that positive changes in body composition can significantly enhance athletic performance [9,10]. Improving body composition through a structured dietary plan can also provide other benefits such as increased strength, agility, and endurance [5,6,11].

Athletes' nutritional strategies and body composition outcomes can vary depending on their level of professionalism. Professional athletes often benefit from more structured training regimens under the supervision of multidisciplinary teams, including nutritionists, strength coaches, and physicians [12,13]. These athletes typically follow individualized dietary plans based on physiological and metabolic needs [14]. On the contrary, most nonprofessional athletes follow self-directed training schedules and more general nutritional habits, which may not sufficiently meet their physiological

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needs. This discrepancy contributes to notable physiological differences. Professional athletes often present with lower FM and higher FFM, reflecting more optimal metabolic efficiency and closer alignment between energy intake and expenditure due to structured training and individualized nutrition plans [15–17].

Tools such as the Athlete Diet Index (ADI) have emerged as valuable resources for assessing diet quality in athletic populations [18]. The ADI assesses the quality of an athlete's diet based on various criteria, including intake of major nutrients (protein, carbohydrates, fats), number of meals, eating habits, and supplement use [18]. The ADI determines how much an athlete's diet meets their needs and identifies the weaknesses [19].

Despite the recognized importance of nutrition and body composition in athletic outcomes, few studies have simultaneously examined both domains in professional and nonprofessional athlete populations. Understanding these differences can improve nutrition and training recommendations for different athletic levels. Moreover, the application of ADI in comparative research across different levels of athletic professionalism has been limited. Thus, this study aims to address this gap by directly comparing the Athlete Diet Index scores and body composition parameters between professional and nonprofessional athletes. In doing so, we also seek to explore how differences in training and nutritional practices may influence body composition and performance.

We hypothesize that professional athletes will exhibit significantly higher ADI scores and more favorable body composition profiles than nonprofessionals. The findings of this study will help develop more effective, evidence-based training and dietary planning strategies for both professional and nonprofessional athletes.

## **2. Materials and methods**

### **2.1. Study design**

This comparative cross-sectional study was carried out with professional and nonprofessional athletes in Tehran. The reporting of this study adheres to the guidelines outlined by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [20].

### **2.2. Ethical approval**

This study was conducted according to the Declaration of Helsinki's guidelines [21], and all procedures involving human subjects were approved by the Tehran University of Medical Sciences Ethic Committee (Ethic number: IR.TUMS.MEDICINE.REC.1402.194). All subjects were given written and verbal information about the study before signing an informed consent form.

### **2.3. Participants**

A convenience sampling method was used to ensure accessibility to both professional and nonprofessional athletes, and 183 athletes were selected, including 99 professional and 84 nonprofessional athletes. The required sample size was calculated using the formula for comparing two means in independent groups, considering a 3% difference in FM percentage with an 80% power and 95% confidence interval. Based on previous studies ( $SD = 4.5$ – $5.5$ ), the estimated sample size was 106, which increased to 116 to account for a 10% dropout rate [22]. Participants were recruited from a variety of sports disciplines through sports federations, professional clubs (e.g. Peykan, Persepolis), including track and field, cycling, team sports, and combat sports associations in Tehran.

In this study, we defined a professional athlete as someone who trains more than 10 hours per week under the supervision of a coach to compete in a given season. Non-professional athletes train less than 10 hours per week [23]. The inclusion criterion was healthy male and female athletes aged 18–40 years, without any diagnosed chronic disease. We excluded athletes who participated in recreational sports, defined as engaging in physical activity for leisure without structured training or competition.

## 2.4. Anthropometry

Upon arrival at the Sports Medicine Research Center (SMRC), Patients' height was measured without shoes using a wall-mounted stadiometer (Seca, Germany) and weight was measured using a digital scale (Seca 808, Germany) while wearing light clothing. Body Mass Index (BMI) was calculated as weight in kilograms divided by the square of height in meters ( $\text{kg}/\text{m}^2$ ). Bioelectrical Impedance Analysis (BIA) was employed as a method for assessing body composition, specifically measuring FM and FFM. Measurements of this study were conducted using a single-frequency (50/60 Hz) bioimpedance analyzer (Tanita BC-418, Tokyo, Japan) [24]. To ensure valid and consistent results, participants were instructed to fast for 12 hours, avoid caffeine, alcohol, diuretics, and vigorous physical activity for 24 hours prior to testing, and void their bladder immediately before the assessment. They were also advised to maintain their usual daily fluid intake during the 24 hours preceding the test to support euhydration without overcompensation. All BIA measurements were conducted between 7:00 and 9:00 AM, following a 10-minute standing rest to stabilize fluid distribution. Measurements were performed with participants barefoot and wearing minimal, lightweight clothing to ensure consistency. These protocols were implemented to minimize intra-individual variability and are aligned with best-practice recommendations for BIA assessment [25–29].

## 2.5. Dietary assessment

The ADI is a validated dietary assessment tool developed by sports nutrition experts at the University of Sydney to evaluate athletes' dietary quality [18]. It provides a composite score out of 125, based on adherence to the Australian Guide to Healthy Eating and international sports nutrition recommendations. The score is calculated from three subdomains: Core nutrition (80 points), assessing the frequency and adequacy of food group consumption such as fruits, vegetables, grains, dairy, and meats; Special nutrients (35 points), evaluating the intake of key micronutrients such as iron and calcium; and Dietary habits (10 points), which includes hydration practices, meal timing, restrictive eating behaviors, culinary skills, and eating frequency. ADI scores are categorized to enhance interpretability and practical application, with scores of  $\geq 90$  indicating gold that meets sports nutrition standards, 66–89 reflecting silver with room for improvement, and  $\leq 65$  suggesting bronze, which indicates potential nutritional risks. This scoring framework has been validated in previous studies and provides a practical tool for coaches, dietitians, and performance staff to identify dietary strengths and risks in athletes and tailor nutrition strategies accordingly [18,19,30]. Although some variables, such as food intolerances and training load, are not included in the numerical scoring, they offer complementary information that supports individualized dietary interpretation. In this study, the ADI questionnaire was administered electronically on the Porslin platform.

## 2.6. Physical activity assessment

Physical activity was measured using the short-form International Physical Activity Questionnaire (IPAQ) [31], consisting of seven items assessing vigorous, moderate, and walking activities over the past week, along with sedentary time. Activity durations (minutes/week) were multiplied by their respective metabolic equivalents (METs; vigorous = 8.0, moderate = 4.0, walking = 3.3) to calculate total activity scores. Participants were categorized into low, moderate, or high physical activity levels based on these scores.

## 2.7. Statistical analysis

All statistical analyses were performed using STATA software version 17, and statistical significance was set at a P-value  $< 0.05$ . The normality of data distribution was assessed using the Kolmogorov – Smirnov test. All quantitative variables demonstrated normal or approximately normal distributions. Quantitative data were summarized as mean  $\pm$  standard deviation and categorical variables as frequencies and percentages. Independent t-tests were employed to compare mean values of athletes' main variables – including body composition, FM percentage, FFM percentage, and dietary index scores – between professional and non-professional athlete groups. Chi-square tests were used to compare categorical baseline characteristics between groups. A two-way analysis of variance (ANOVA) was conducted to examine the interaction effects

and main effects of athletic levels (professional vs. nonprofessional) and dietary quality index categories on body composition variables (FM percentage and FFM percentage). To control for potential confounding, age and gender were included as covariates. Post-hoc Bonferroni correction was applied to account for multiple comparisons and minimize the risk of Type I errors. The comparison of FM percentage and FFM percentage between athletic levels, were visualized using box plots. Also, ADI categories (gold, silver, bronze) were compared between athlete groups using stacked bar charts and chi-square analysis.

### 3. Results

#### 3.1. Demographic and baseline characteristics of participants

This study included 183 athletes (99 professional, 84 nonprofessional) participating in various sports. In addition, the demographic characteristics of the participants, including education level, supplement use, competition levels, physical activity, age, gender, and occupation are reported.

##### 3.1.1. Education level, supplement use, age, gender, and occupation

Education level distribution between professional and nonprofessional athletes did not show a statistically significant difference ( $p = 0.725$ ). The highest percentage of participants in both groups held a high school diploma (36.1%), followed by those with a bachelor's degree (23.9%) and postgraduate education (21.8%). Regarding the use of sports supplements, a significant difference was observed between the two groups ( $p = 0.028$ ). Professional athletes reported a higher prevalence of supplement use (40.4%) compared to nonprofessional athletes (25.0%). However, no significant difference was found in the use of dietary supplements ( $p = 0.192$ ). Regarding gender distribution, no statistically significant difference was observed between groups ( $p = 0.243$ ). Male athletes comprised a slightly higher proportion among professionals (55.6%) compared to nonprofessionals (47.6%), whereas female athletes were more represented in the nonprofessional group (52.4% vs. 44.4%). Occupational status also did not differ significantly between groups ( $p = 0.112$ ). University students made up the largest proportion in both groups, especially among nonprofessionals (57.3%), while professional athletes were more frequently self-employed (29.3%) or reported "athlete" as their

**Table 1.** Demographic characteristics of professional and nonprofessional athletes.

| Variable               | Total (%) | Professional athletes (%) | Non-professional athletes (%) | p-value |
|------------------------|-----------|---------------------------|-------------------------------|---------|
| Gender                 |           |                           |                               | .243    |
| Male                   | 51.9      | 55.6                      | 47.6                          |         |
| Female                 | 48.1      | 44.4                      | 52.4                          |         |
| Occupation             |           |                           |                               | .112    |
| Self-employed          | 24.86     | 29.29                     | 19.51                         |         |
| University student     | 44.75     | 34.34                     | 57.32                         |         |
| Governmental position  | 8.29      | 9.09                      | 7.32                          |         |
| Athlete                | 22.10     | 27.27                     | 15.85                         |         |
| Education level        |           |                           |                               | .725    |
| Less than high school  | 13.1      | 14.2                      | 11.0                          |         |
| High school diploma    | 36.1      | 35.3                      | 36.9                          |         |
| Bachelor's degree      | 23.9      | 31.3                      | 26.2                          |         |
| Postgraduate degree    | 21.8      | 19.2                      | 25.0                          |         |
| Dietary supplement     |           |                           |                               | .192    |
| No                     | 44.8      | 40.2                      | 50.0                          |         |
| Yes                    | 55.2      | 59.6                      | 50.0                          |         |
| Sports supplement      |           |                           |                               | .028    |
| No                     | 66.7      | 59.6                      | 75.0                          |         |
| Yes                    | 33.3      | 40.4                      | 25.0                          |         |
| Physical activity      |           |                           |                               | .436    |
| Low                    | 10        | 9.7                       | 10.5                          |         |
| Moderate               | 29.3      | 25.8                      | 35.1                          |         |
| High                   | 60.7      | 64.5                      | 54.4                          |         |
| Competition level      |           |                           |                               | .001    |
| National/international | 22.9      | 31.3                      | 13.1                          |         |
| Regional/provincial    | 48.1      | 50.5                      | 45.2                          |         |
| University level       | 29.0      | 18.2                      | 41.7                          |         |

Values are presented as percentages (%).

P-values represent differences between groups assessed using the Chi-square test.

$p < 0.05$  was considered statistically significant.

**Table 2.** Comparison of body composition and BMI between professional and nonprofessional athletes.

| Variable                     | Professional athletes (Mean $\pm$ SD) | Non-professional athletes (Mean $\pm$ SD) | t-statistic | p-value |
|------------------------------|---------------------------------------|-------------------------------------------|-------------|---------|
| Fat Mass percentage (%)      | 16.2 $\pm$ 7.1                        | 18.8 $\pm$ 9.9                            | 2.07        | 0.019   |
| Fat Free Mass percentage (%) | 80.8 $\pm$ 6.8                        | 78.0 $\pm$ 9.6                            | 2.33        | 0.023   |
| BMI                          | 23.0 $\pm$ 13.2                       | 23.3 $\pm$ 13.4                           | 1.31        | 0.240   |

Values are expressed as mean  $\pm$  standard deviation (SD).

Statistical differences between groups were assessed using independent t-tests.

$p < 0.05$  was considered statistically significant.

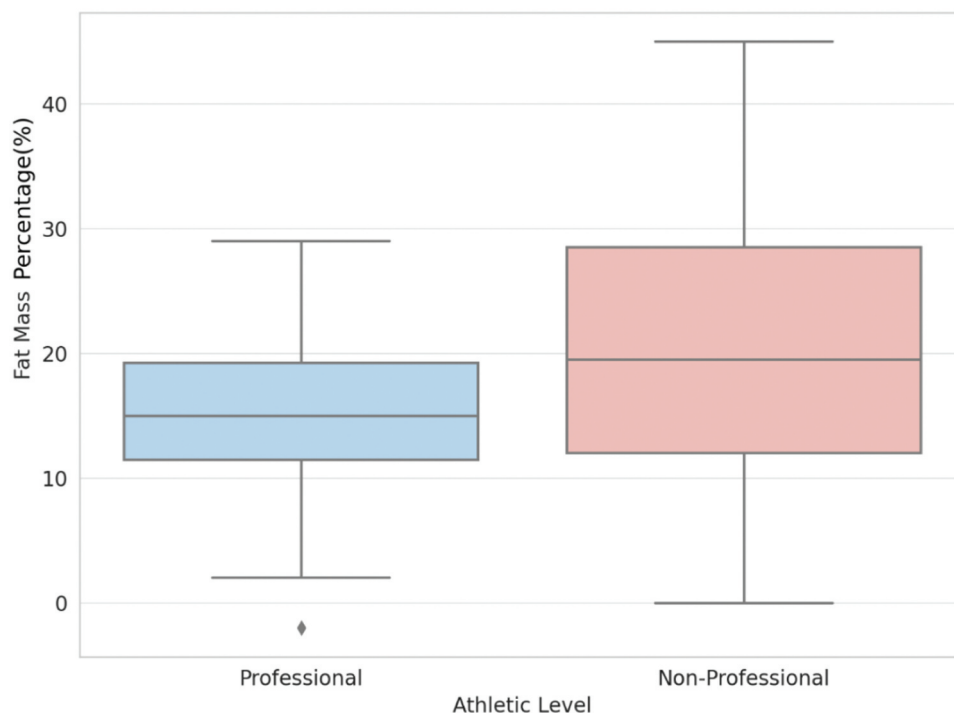
occupation (27.3%) (Table 1). In addition, the age distribution between professional and nonprofessional athletes did not show a statistically significant difference ( $p = 0.960$ ). The mean age for both groups was similar, with professional athletes having a mean age of 24.8 years and nonprofessional athletes having a mean age of 24.9 years.

### 3.1.2. Competition levels in professional vs. non-professional athletes

A significant difference was observed in the distribution of competition levels between professional and nonprofessional athletes ( $p = 0.001$ ). Professional athletes were more commonly involved in national or international competitions, with 31.3% reporting participation at this level, compared to only 13.1% of nonprofessionals. Conversely, university-level competitions were more prevalent among nonprofessional athletes (41.7%), whereas a smaller proportion of professionals (18.2%) competed at this level (Table 1).

### 3.2. Differences in FM percentage

The results indicate that professional athletes had significantly lower FM percentages than their nonprofessional counterparts ( $p = 0.019$ ). The mean FM percentage for professional athletes was 16.2%  $\pm$  7.1, whereas nonprofessional athletes exhibited a higher mean FM percentage of 18.8%  $\pm$  9.9 (Table 2 , Figure 1).

**Figure 1.** Comparison of FM percentage between athletic levels.

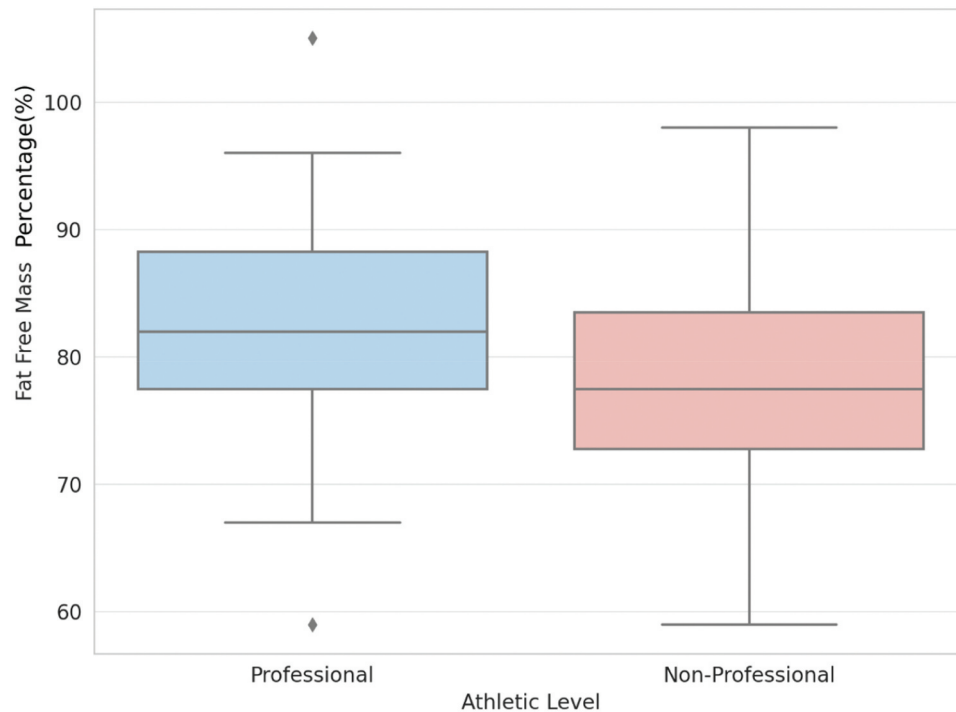


**Figure 2.** Comparison of FFM percentage between athletic levels.

**Table 3.** ADI scores in professional vs. nonprofessional athletes.

| ADI domains       | Professional (Mean $\pm$ SD) | Non-professional (Mean $\pm$ SD) | t-statistic | p-value |
|-------------------|------------------------------|----------------------------------|-------------|---------|
| ADI total score   | 88.6 $\pm$ 17.8              | 73.5 $\pm$ 22.5                  | 5.94        | < 0.001 |
| Core nutrition    | 59.7 $\pm$ 15.7              | 54.4 $\pm$ 23.9                  | 5.40        | 0.015   |
| Dietary habits    | 5.6 $\pm$ 2.2                | 5.2 $\pm$ 2.3                    | 1.32        | 0.089   |
| Special nutrients | 20.1 $\pm$ 4.8               | 16.8 $\pm$ 5.5                   | 4.22        | < 0.001 |

Values are expressed as mean  $\pm$  standard deviation (SD).

Independent t-tests were used to assess between-group differences.

$p < 0.05$  was considered statistically significant.

### 3.3. Differences in FFM percentage

FFM percentage was significantly higher in professional athletes than in nonprofessionals ( $p = 0.023$ ). The mean FFM percentage for professional athletes was  $80.8\% \pm 6.8$ , while nonprofessional athletes had a lower mean of  $78.0\% \pm 9.6$  (Table 2, Figure 2).

### 3.4. Differences in ADI

The ADI total score was significantly higher in professional athletes compared to nonprofessionals ( $p < 0.001$ ), indicating greater adherence to sports nutrition recommendations. Significant group differences were also observed in the core and special nutrition components, while the dietary habits score did not differ between groups ( $p = 0.089$ ) (Table 3). Moreover, the distribution of dietary quality levels – categorized as gold, silver, and bronze – varied significantly between groups ( $p < 0.001$ ), with professional athletes more frequently classified in the gold category, while nonprofessionals were predominantly in the silver and bronze levels (Figure 3). To further explore potential interactions between gender and professional status, ADI scores were stratified by gender. Both male and female professional athletes indicated higher ADI scores compared to their nonprofessional peers. The overall pattern remained consistent across genders, suggesting a robust association between professional status and ADI total scores.

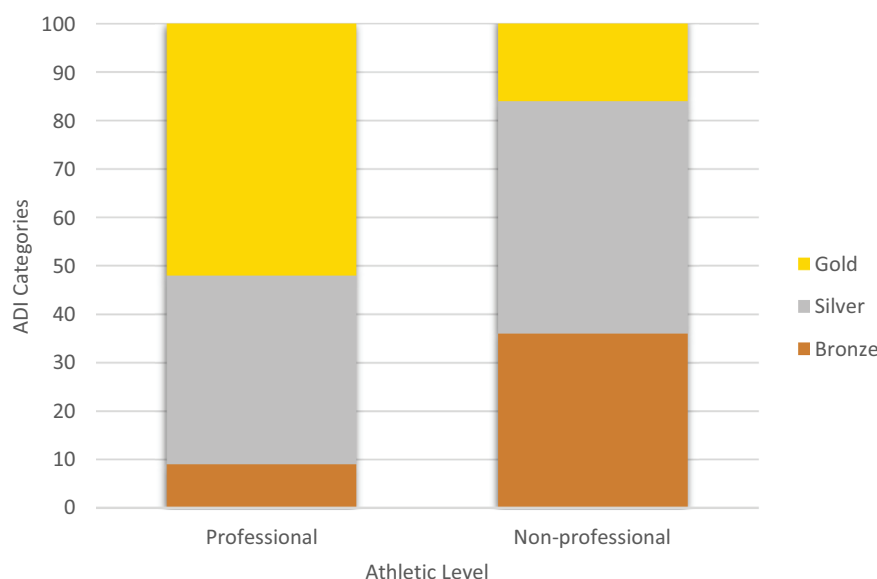


**Figure 3.** Relationship between ADI total score and athletic level, based on the Chi-square test ( $p < 0.05$ ).

### 3.5. Interaction between ADI and body composition

A two-way ANOVA was performed to assess the interaction between ADI categories and athletic level on FM percentage and FFM percentage. A significant interaction was observed for FM percentage ( $F = 3.11$ ,  $p = 0.047$ ), indicating that the effect of ADI on FM differed between professional and nonprofessional athletes. Specifically, professional athletes with high ADI scores had the lowest FM values. However, no significant interaction or main effect was found for FFM percentage ( $p = 0.149$ ).

## 4. Discussion

This study aimed to compare the ADI and body composition between professional and nonprofessional athletes. The findings support the hypothesis that professional athletes exhibit significantly higher ADI scores and more favorable body composition profiles compared to nonprofessional athletes.

Professional athletes exhibited a lower FM percentage of  $16.2\% \pm 7.1\%$  and a higher FFM percentage of  $80.8\% \pm 6.8\%$ , relative to nonprofessionals. This difference suggests that professional athletes benefit from more structured training regimens that help reduce FM and increase FFM, reflecting greater metabolic efficiency and a closer alignment between energy intake and expenditure. In line with these findings, professional athletes also demonstrated significantly higher ADI scores, indicating better adherence to recommended dietary practices [19].

Our results are consistent with previous studies that have shown professional athletes tend to have lower FM percentages and higher FFM compared to nonprofessionals. For instance, Slimani et al. (2018) found similar trends, with lower body fat percentage in elite athletes than amateur players [15]. Similarly, Papaevangelou et al. (2012) reported that professional athletes had more favorable body compositions due to their structured training and nutrition regimens [17]. Moreover, the higher ADI scores observed in professional athletes in this study align with findings from Capling et al. (2020), who noted that elite athletes adhere more closely to sports nutrition guidelines, leading to higher-quality diets compared to their nonprofessional counterparts [19].

Several factors may contribute to the observed differences between professional and nonprofessional athletes in terms of body composition and dietary quality. Professional athletes typically undergo more rigorous and structured training programs, which are often designed with specific goals in mind, such as fat reduction and muscle gain. These regimens are typically supervised by a multidisciplinary team, including coaches, nutritionists, and physicians, ensuring that their training is

optimized for performance and body composition. On the other hand, nonprofessional athletes often follow less structured training schedules that may not be sufficient to elicit significant improvements in body composition [17].

Another critical factor influencing the body composition of professional athletes is the availability of personalized dietary plans developed by nutrition experts. As shown by the significantly higher ADI scores in professional athletes, these athletes are more likely to adhere to individualized nutritional recommendations tailored to their specific needs. Non-professional athletes, in contrast, may rely on general dietary habits or self-directed nutritional choices that may not meet their physiological demands as effectively [18]. Our findings also revealed a notable difference in supplement usage between the two groups, with a significantly greater proportion of professional athletes reporting sports supplements consumption, whereas the use of dietary supplements did not differ significantly between groups. This suggests that professional athletes may adopt a more strategic approach to supplementation in support of their training and body composition goals. However, it is important to note that supplementation should complement, not replace, a balanced diet [2]. Several studies have shown that sports supplements may influence body composition by promoting lean mass gains, reducing fat mass, or improving recovery and training intensity [32–35]. For example, evidence supports the role of certain ergogenic and protein-based supplements in increasing FFM and supporting muscular development in athletes under structured training [36,37].

Given the higher prevalence of sports supplement use among professional athletes in our sample, this factor may have contributed to the more favorable body composition observed in this group. While our study assessed the general use of dietary and sports supplements, we did not collect data on the specific types of supplements used (e.g. creatine, protein, caffeine), nor their dosages or duration.

Although our study provides valuable insights, it is important to recognize several limitations. First, the cross-sectional design of our study only provides a snapshot of athletes' body composition and dietary habits at a single point in time. Longitudinal studies are needed to assess the long-term effects of dietary practices and training regimens on body composition and athletic performance [38]. Second, although we employed a convenience sampling method to include athletes from different sports federations and clubs, the sample may not be fully representative of all athletes, particularly those from non-elite backgrounds. Additionally, the exclusion of athletes with chronic diseases may limit the generalizability of our findings to the broader athletic population [39]. Although participants were provided with detailed instructions for pre-assessment fasting, hydration, and physical activity, minor variability in compliance, particularly regarding 24-hour exercise abstention, may have influenced BIA results. This should be considered as a potential limitation in interpreting body composition outcomes.

Moreover, our data on supplement use were limited to general categories (dietary vs. sports supplements), lacking detail on the specific types, dosages, or duration. This restricts our ability to assess how individual supplements such as creatine or protein may have influenced fat-free mass outcomes. Although athletes from various sports disciplines were included, the number of participants per sport was too small for separate analysis. This heterogeneity may have influenced body composition results and should be addressed in future sport-specific studies.

Moreover, a potential limitation of this study is the skew in the nonprofessional athlete group, as it was predominantly composed of university level athletes. This could have influenced their training regimens and dietary habits, potentially affecting the generalizability of the findings.

Future research should focus on exploring the longitudinal effects of dietary interventions and training regimens on body composition in both professional and nonprofessional athletes. Additionally, investigating the role of other healthy lifestyle factors, such as sleep quality, stress management, and psychological factors, in shaping athletes' body composition and dietary behaviors could provide a more comprehensive understanding of how lifestyle factors influence athletic performance [40–42]. Further studies could also investigate the impact of dietary supplementation on body composition, particularly in nonprofessional athletes who may have limited access to professional nutrition guidance [43]. Additionally, sport-specific studies are needed to address the heterogeneity in body composition results across different athletic disciplines. Finally, exploring the potential influence of demographic variables, such as age and gender, as well as the effectiveness of various dietary strategies, including personalized nutrition plans, could help refine the recommendations for different athlete populations [2,44–47].

## 5. Conclusion

In conclusion, our study highlights significant differences in both body composition and dietary quality between professional and nonprofessional athletes. Professional athletes tend to have lower FM percentages, higher FFM percentage, and better adherence to dietary guidelines compared to nonprofessional athletes. These insights can inform targeted interventions by coaches and nutritionists aiming to optimize athlete health and performance at various competitive levels. Our findings contribute to the growing body of evidence supporting the role of personalized nutrition and training in improving body composition in athletes.

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## Abbreviations

|        |                                                                      |
|--------|----------------------------------------------------------------------|
| ADI    | Athlete Diet Index                                                   |
| BIA    | Bioelectrical Impedance Analysis                                     |
| BMI    | Body Mass Index                                                      |
| FM     | Fat Mass                                                             |
| FFM    | Fat Free Mass                                                        |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |
| IPAQ   | International Physical Activity Questionnaire                        |
| SD     | Standard Deviation                                                   |
| MET    | Metabolic Equivalent of Task                                         |
| ANOVA  | Analysis of Variance                                                 |

## Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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