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Assessing Nutritional Balance and Its Influence on Physical Activity and Performance Among University Sports Students

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ABSTRACT. Purpose: This study analyzes the nutritional balance both quantitative and qualitative of meals provided at university dining halls in Oran and explores how this balance relates to the physical activity levels of students at the Institute of Physical Education and Sports. **Method:** The research involved 134 male students (ages 18-25 years, body weight: 71.84±4.55 kg, height: 174.66±8.52 cm) living in university dormitories "S2," "S5," and "S1." Food portions were measured, and students' energy expenditure from physical activity was calculated, following energy value standards set by Gandy, Madden, and Holdsworth (2012). **Results:** The students' average daily energy intake was 2729.93 kcal, while their energy expenditure from physical activity averaged 3277.66 kcal. According to Joan Webster's 2020 guidelines, the recommended energy intake is 3521.6 kcal. The study revealed that energy intake was below recommended levels and energy expenditure was higher, suggesting a need for dietary adjustments to meet energy requirements due to high physical activity levels. **Conclusion:** There is a notable gap between energy intake and expenditure, influenced by poor meal planning rather than economic constraints.

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This imbalance may adversely affect physical performance and cognitive functions. A balanced diet that meets nutritional standards is crucial for optimizing both learning and physical performance.

Keywords: *Nutritional Balance, Major Nutritional Elements, University Dining Halls, Physical Activity, Student Health*

INTRODUCTION

Physical inactivity is recognized as the fourth leading risk factor for global mortality, contributing to 6% of deaths worldwide (Martín-Valero, Rodríguez-Martínez, Cantero-Tellez, Villanueva-Calvero, & Fernández-Martín, 2014; Kesari & Noel, 2024). It is estimated to be a major cause of several significant health conditions, including diabetes (27%), breast and colon cancers (21-25%), and ischemic heart disease (30%)(Kyu et al., 2016).

Physical activity involvement has been confirmed to be beneficial to human physiology because it improves oxygen retention capacity of the lungs and blood circulation, and increases lung capacity (Adel et al., 2019; Qin, Peng, & Wang, 2021). The World Health Organization (WHO) advises that adolescents and young adults engage in moderate to vigorous physical activity daily to counteract sedentary behavior (Bull et al., 2020).

The relationship between physical activity and diet and health has been studied for many years, and the results confirm that regular physical activity and a balanced diet have a direct effect on the prevention of chronic non-communicable diseases(Benchehida et al., 2021; Serrano-Gallén, Arias-Palencia, González-Víllora, Gil-López, & Solera-Martínez, 2022; Yacine et al., 2020).

The predominance of the so-called Western diet (rich in fats, sugars and refined foods, and low in complex carbohydrates and fibre) in various countries and regions of the world, and the progressive decline in the practice of physical activity, have contributed to the increase in the incidence of obesity in recent decades (Beboucha, Belkadi, Benchehida, & Bengoua, 2021; Kopp, 2019). In Algeria, malnutrition was for a long time a primary health risk factor, but in recent decades there has been a transition from deficits to excessive food consumption (Bencharif, Sersar, Touati-Mecheri, Agli, & Oulamara, 2021). In the specific case of obesity, the factors associated with this occurrence are high energy density diets and reduced energy expenditure due to a sedentary lifestyle (Bazshahi, Sheikhhossein, Amini, & Shab-Bidar, 2021; Mahmoud, 2022). Obesity itself is a determining factor in type 2 diabetes, dyslipidemias and hypertension,

as well as increasing the risk of cardiovascular diseases and certain types of cancer (Boudehri, Belkadi, Dahoune, & Atallah, 2023; Fava, Fava, & Agius, 2019). There is evidence that the earlier obesity is established, the greater the risk of obesity in adulthood (Drozdz et al., 2021; Adel Belkadi et al., 2025).

Adequate and healthy nutrition is vital for human growth, survival, and overall well-being. Food serves as fuel, supplying the energy necessary for daily activities(Chrara, Raoui, Belkadi, Hocine, & Benbernou, 2018). Nutritional requirements vary depending on individual factors such as age, activity level, and specific life stages, whether for children, athletes, adults, pregnant women, the elderly, or patients each of whom has unique dietary needs (Amawi et al., 2024).

Assessing nutritional status is essential for evaluating metabolic health and clinical nutrition. This can be achieved through various methods, including anthropometric measurements, biochemical markers, clinical evaluations, and subjective questionnaires (Taberna, Navas-Carretero, & Martinez, 2019).

Indicated that nutritional status of a community is important, as it helps to identify the nutritional level and widespread problems of malnutrition among its individuals. The World Health Organization has cited that malnutrition is the greatest threat to public health. Consequently, some organizations have begun to work with teachers, decision makers, and food service contractors to improve the nutritional content and increase food resources in school cafeterias and canteens, from elementary school to university level. It has been proven that nutrition has a close relationship with success in the educational process in general (Behrman, 1996; Senouci, Asli, Belkadi, Bouhella, & Koutchouk, 2024).

In Algeria, a recent study by Asli (Saddek, Houcine, & Hichem, 2019) evaluated the prevalence of physical activity among the adult population. The findings indicated a relatively low prevalence of leisure-time physical activity (11.0%), with only 4.3% of the population studied accumulating 30 minutes of daily physical activity on five or more days of the week (Hichem, Houcine, & Sadek, 2015).

Scientific research over the past twenty years has confirmed the importance and benefits of proper nutrition and its positive impact on athletic performance (Cherara, Belkadi, Mesaliti, & Beboucha, 2022; Obesity, 2000). There is no doubt now that what an athlete eats and drinks will affect their health, weight, body composition, and fuel sources during and after exercise, especially during sports competitions(A Belkadi & Mime, 2019; Adel Belkadi, Alia, & Mohammed, 2020; Benhammou et al., 2022). Optimal nutrition improves physical activity and athletic performance. Wyszyńska et al (2020) mentioned that nutrition plays a significant role in achieving the desired athletic achievement (Adel Belkadi et al., 2015; Berria, Bachir, Eddine, & Adel, 2018).

In our study, we will examine the dietary system in boarding schools for male students at the Institute of Physical Education and Sports residing in university dormitories "S2," "S5," and "S1." This developmental stage is marked by substantial growth changes, and a balanced diet is crucial for supporting physiological, mental, and motor development. Ferry (2010)Therefore, any imbalance in the diet (quantitative or qualitative) leads to malnutrition, whether it be excess or deficiency (O'Sullivan & Sheffrin, 2003). Melchior (2009) confirms that malnutrition is the lack of compliance of the dietary system with recommended standards, whether they are major or minor nutritional elements. *Malnutrition* refers to deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization (Morales, Montserrat-de la Paz, Leon, & Rivero-Pino, 2024), Studies have also shown that malnutrition is one of the causes of stunted growth (Millward, 2017; Budzulak, Majewska, & Kędzia, 2022; Willya Achmad Et Al., 2023; Adel Belkadi et al., 2025). Based on this context, the authors conducted an analytical study to assess the food provided in university dining facilities and its relationship with the basal metabolic rate and energy expenditure of physical activity among male students from the Institute of Physical Education and Sports residing in dormitories "S2," "S5," and "S1." The study aimed to achieve the following objectives:

- Evaluate the Nutritional Balance: Assess both the qualitative and quantitative aspects of the meals distributed to the students to determine their overall nutritional adequacy.
- Assess Energy Consumption: Compare the energy intake of the study sample with established standards from the World Research Center to identify any discrepancies.
- Compare Energy Expenditure and Intake: Analyze the relationship between the energy expended through physical activity and the energy consumed from meals on a daily basis.

MATERIALS AND METHODS

Participants

From April to June 2024, this observational, descriptive, and cross-sectional study was carried out at the Sports University in Oran, Algeria. 134 students between the ages of 18 and 25 made up the sample, who were chosen at random by the general population.

Exclusion criteria: Restrictive diet for health reasons, recovering from injury or illness, Dietary practices and level of physical activity were the main

factors, with BMI acting as the dependent variable. Gender was also considered as an adjustment variable. This study was approved by the Research Ethics Committee of sports institute of physical education and sports (IEPS: 20052024.1.003).

Anthropometric assessment

Instruments used were a flexible steel tape, 7 mm wide, and a counterweight scale with a capacity of 150 kg and an accuracy of 100 g, with a stadiometer included.

The International Physical Activity Questionnaire, short format, was used to estimate energy expenditure in physical activity.

Assessment of dietary habits

A survey was constructed based on the recommendations of the current dietary guide for the Algerian population. This consisted of two rating scales: one considered food selection and frequency of weekly consumption, and the other considered the dietary behaviours that accompanied the intakes. Eating habits were categorized as healthy, moderately healthy and unhealthy based on the totality of responses. In the rating scale of food selection and frequency of food consumption, foods were divided into three meals (breakfast, lunch, and dinner) according to their recommended consumption. The first meal group included foods consumed in the morning five times a week, the second meal group included foods consumed in the middle of the journey (lunch) five times a week, and the third meal group included dinner at the evening. On the scale assessing eating behaviours, these were divided into seven items, based on healthy recommendations, and were given a score of 1 for each behaviour selected.

Basal Energy Expenditure (BEE)

Refers to the amount of energy that your body requires at rest to maintain basic bodily functions such as breathing, circulation, and cell production. The most used equation to estimate BEE is the Harris-Benedict equation, which takes into account age, sex, weight, and height.

The formula is as follows:

For men: BEE = 88.36 + (13.4 x weight in kg) + (4.8 x height in cm) - (5.7 x age in years)
For women: BEE = 447.6 + (9.2 x weight in kg) + (3.1 x height in cm) – (4.3 x age in years)
level of physical activity using the following factors:
Sedentary (little or no exercise): BEE x 1.2

Lightly active (light exercise/sports 1-3 days/week): BEE x 1.375
Moderately active (moderate exercise/sports 3-5 days/week): BEE x 1.55
Very active (hard exercise/sports 6-7 days a week): BEE x 1.725
Extra active (very hard exercise/sports or physical job): BEE x 1.9

By multiplying your BEE by the appropriate activity factor, you can estimate your Total Energy Expenditure (TEE), which refers to the total amount of calories you burn in a day, including both BEE and physical activity.

MyFitnessPal

Is a mobile app and website that offers users tools to track their diet and exercise habits. It allows users to log their food intake, track their daily calorie intake, and set nutrition goals. The app provides a database of over six million foods, including popular restaurant items, and allows users to scan barcodes for quick and easy logging. MyFitnessPal also offers features to track physical activity, set weight loss goals, and connect with friends for support and motivation.

This work was authorised by the sports Research Ethics Committee (SREC) of the Institute of Physical Education and sports.

Statistical analysis

Variables were expressed as mean and standard deviation, and ANOVA was used for comparison of means. For association of categorical variables, chi-square test was used, and Fisher's test was applied when necessary. A value of $p<0.05$ was considered significant. Statistical analysis was performed using SPSS 22 version 2016. Data were collected in a group setting in a classroom without time control, with the permission of each student by means of an informed consent letter.

RESULT

Table 1. Body Mass Index (BMI), normal weight and overweight, in total sample and according to sex, in students Institute of Physical Education (IEPS)

	Total (n=134)	**Women (n=60)**	**Men (n=74)**
BMI (Mean ± SD)	23.35 ± 3.08	23.08 ± 3.03	23.56 ± 3.06
Normal weight (BMI < 24.99) (FA, %)	104 (78)	48 (80)	56 (76)
Overweight (BMI > 25) (FA, %)	30 (22)	12 (20)	18 (24)

Table 2. Distribution of dietary habits and physical activity level with Body Mass Index (BMI) in students of the Institute of Physical Education (IEPS)

Variables	AF (%)	BMI (Mean ± SD)
Food selection		
Healthy	87 (65)	23.09 ± 2.79
Moderately healthy	43 (32)	23.67 ± 3.54
Unhealthy	10 (8)	23.25 ± 4.07
Eating behaviour		
Healthy	97 (72)	23.37 ± 2.83
Moderately healthy	26 (20)	22.78 ± 3.15
Unhealthy	4 (3)	25.49 ± 3.69
Level of Physical Activity		
High	97 (72)	23.64 ± 2.89
Medium	29 (22)	22.47 ± 2.51
Under	8 (6)	24.52 ± 4.72

Note: Variables are expressed as absolute frequency (AF): percentages of cases (%), BMI as Mean ± Standard Deviation (SD).

The population studied had a higher prevalence of normal weight, especially females. Most students made moderately healthy food choices and exhibited healthy eating behaviour. Moreover, a higher proportion of both genders engaged in high physical activity. However, it is important to note that some students consumed ultra-processed foods or bakery products, and some lacked essential macronutrients. Additionally, the educational establishments where the students studied did not offer healthy food alternatives. It should be noted that the measurements were taken at the beginning of the degree course, before the students had incorporated more advanced eating habits.

Table 3 provides information on the macronutrient composition of three daily meals, measured in kilocalories (kcal) and grams (g), for a period of five days. The macronutrients considered are fats, protein, and carbohydrates. The average macronutrient intake across the five days is also provided, along with the standard deviation, maximum, and minimum values.

Table 3. Macronutrient Composition of Three Daily Meals

Days	Fats (kcal)	Fats (g)	Protein (kcal)	Protein (g)	Carbohydrate (kcal)	Carbohydrate (g)
Sunday	626.66	69.62	278.392	69.59	2908.58	727.14
Monday	1415.18	27.6	628.72	157.18	1970.84	492.7
Tuesday	1003.29	111.48	445.88	111.47	2229.81	557.34
Wednesday	412.35	45.82	183.242	45.81	1374.46	343.61
Thursday	723.32	80.37	321.48	80.37	1616.61	404.19
Average	836.36	92.506	371.544	92.084	1792.66	445.18
STDEV	357.51	50.9	156.940	28.766	414.31	148.5
Max	1415.18	157.24	628.72	157.18	2908.58	727.14
Min	626.66	45.82	183.24	69.59	1374.46	343.61

The table shows that the highest fat intake occurred on Monday, with a total of 1415.18 kcal (27.6 g), while the lowest was on Wednesday, with a total of 412.35 kcal (45.82 g). Similarly, the highest protein intake was on Monday, with a total of 628.72 kcal (157.18 g), while the lowest was on Wednesday, with a total of 183.242 kcal (45.81 g). The highest carbohydrate intake occurred on Sunday, with a total of 2908.58 kcal (727.14 g), while the lowest was on Wednesday, with a total of 1374.46 kcal (343.61 g).

The average macronutrient intake across the five days shows that, on average, the participants consumed 836.36 kcal (92.506 g) of fats, 371.544 kcal (92.084 g) of protein, and 1792.66 kcal (445.18 g) of carbohydrates. The standard deviation values indicate the variability in macronutrient intake across the five days, with the highest variability observed for carbohydrates.

Table 4 shows the evaluation of animal protein and vegetable ratio of the total protein found in the three meals. The table includes the percentage of protein from animal and vegetable sources, the calories and grams of protein from each source.

Looking at the data, we can see that the average percentage of protein from animal sources is 84.48%, while the average percentage of protein from vegetable sources is 15.52%. The standard deviation for both percentages is relatively high, indicating a wide variation between the meals.

Table 4. Evaluation of animal Protein and vegetable ratio of total Protein found in the value of the three meals

Days	Protein Animal (%)	Protein Animal (kcal)	Protein Animal (g)	Protein Vegetal (%)	Protein Vegetal (kcal)	Protein Vegetal (g)
Sunday	60.55	242.20	60.55	39.44	157.76	39.44
Monday	94.57	207.90	51.98	5.42	11.92	2.98
Tuesday	97.31	396.40	99.10	2.68	10.92	2.73
Wednesday	79.56	303.20	75.80	20.43	77.88	19.47
Thursday	90.38	130.08	32.52	9.61	13.84	3.46
Average	84.48	255.88	71.39	15.52	54.46	15.07
STDEV	14.98	100.32	24.23	14.98	64.37	15.54
Max	97.31	396.40	99.10	39.44	157.76	39.44
Min	14.98	100.32	32.52	2.68	10.92	2.73

The maximum percentage of protein from animal sources is 97.31%, while the minimum is 14.98%. On the other hand, the maximum percentage of protein from vegetable sources is 39.44%, while the minimum is 2.68%.

Overall, this table provides valuable information on the sources of protein in the three meals, showing a clear predominance of animal protein. However, it's important to note that the quality of protein from animal and vegetable sources can vary, and that a balanced and varied diet is key to meeting nutritional needs.

Table 5. Evaluation of animal fat and vegetable ratio of total fats found in the value of the three meals

Days	Fats animal (%)	Fats animal (kcal)	Fats animal (g)	Fats vegetal (%)	Fats vegetal (kcal)	Fats vegetal (g)
Sunday	27.37	254.07	28.23	72.62	674.1	74.90
Monday	13.55	96.66	10.74	86.44	616.59	68.51
Tuesday	15.01	66.51	7.39	84.98	376.38	41.82
Wednesday	12.68	83.79	9.31	87.31	576.63	64.07
Thursday	21.99	245.97	27.33	78.00	872.1	96.90
Average	19.33	149.4	16.6	80.66	623.16	69.24
STDEV	34.11	92.51	10.27	65.88	178.65	19.85
Max	22.56	254.07	28.23	77.43	872.1	96.90
Min	14.98	100.3	32.52	84.98	376.38	41.82

Table 5 provides information on the percentage and amount of animal fat and vegetable fat found in the three meals on different days. The table shows that on average, 19.33% of the total fat intake was from animal sources, while 80.66% was from vegetable sources. The highest percentage of animal fat was found on Thursday at 21.99%, while the lowest was on Wednesday at 12.68%. On the other hand, the highest percentage of vegetable fat was found on Thursday at 78.00%, while the lowest was on Tuesday at 84.98%.

The average amount of animal fat consumed per day was 16.6g, while the average amount of vegetable fat consumed per day was 69.24g. The highest amount of animal fat was consumed on Sunday at 28.23g, while the lowest was on Tuesday at 7.39g. The highest amount of vegetable fat was consumed on Thursday at 96.90g, while the lowest was on Tuesday at 41.82g.

Overall, the table shows that the majority of fat intake came from vegetable sources, with only a small percentage coming from animal sources. This suggests that the meals consumed were likely plant-based or low in animal products.

Table 6. Correlation between Age, Height, Weight, Energy Intake and Expenditure, and Recommended Energy Intake for students

Sample	Age	Height	Weight	Energy Intake	Energy Expenditure	Pearson Correlation Coefficient	Recommended Intake Energy
(n=134)	21.8 ± 1.2	175.3 ± 6.2	72.6 ± 8.1	2729.93	3277.66	-0.09*	3521.6

Note: *$p < .05$

Table 6 shows the correlation between age, height, weight, energy intake, energy expenditure, and recommended energy intake for a sample of 120 students. The data indicates that the average age of the students in the sample is 21.8 years, with a standard deviation of 1.2 years. The average height is 175.3 cm, with a standard deviation of 6.2 cm, and the average weight is 72.6 kg, with a standard deviation of 8.1 kg.

The average energy intake of the students is 2729.93 kcal, and the average energy expenditure is 3277.66 kcal. The Pearson correlation coefficient between energy intake and expenditure is -0.09, indicating a weak negative correlation between the two variables.

The recommended energy intake for the students is 3521.6 kcal. It is important to note that this value may vary depending on factors such as physical activity level, body composition, and overall health status. Therefore, individualized recommendations should be provided based on a comprehensive assessment of each individual's needs.

DISCUSSION

According to the results, it was found that the population studied had a percentage of normal weight above the representative values of the Algerian population. In this sense, it should be borne in mind that the measurements of those assessed correspond to the beginning of the degree course, when they may not yet have incorporated the eating habits of a more advanced student (Benbernou, Bennama, Belkadi, Boukchiche, & Koutchouk, 2022; Mohamed, Mohamed, Mohammed, Mokrani, & Belkadi, 2019). On the other hand, food choices were mostly moderately healthy, sometimes consuming ultra-processed foods or bakery products and, in other cases, lacking essential macronutrients such as meat, eggs, vegetables, fruit and seeds. It is important to note that in the educational establishments where the students studied, the canteens available do not offer more or less healthy alternatives, which would suggest that the pattern of food selection is the same as outside the aforementioned establishments. In turn, eating behaviours were mostly healthy, respecting 4 minimum daily intakes, ensuring breakfast and lunch, and avoiding prolonged fasting, as the most prominent. This result did not coincide with the findings obtained by (Oulamara, Agli, & Frelut, 2009), referring to changes in lifestyle, reflected in eating habits and diet quality, respectively. In the same vein, in the city of Oran, Algeria, several studies recognized higher or lower than recommended daily intake and a low level of physical activity as variables related to overweight (Berria et al., 2018; Chrara et al., 2018; Okati-Aliabad, Ansari-Moghaddam, Kargar, & Jabbari, 2022; Youcef, Mokhtar, & Adel, 2022). With regard to this discrepancy with the results found in the present study, it should be added that the Physical Education curriculum does not include specific content related to healthy eating habits (Cherara et al., 2022; McLoughlin et al., 2019), which would suggest that the behaviours shown are acquired spontaneously from childhood and adolescence (Abdelhafez, Akhter, Alsultan, Jalal, & Ali, 2020; Mokémiabéka, Ombeni, & Mabossy-Mobouna*, 2022; Warburton, 2006; Yahia, Wang, Rapley, & Dey, 2016). In relation to the level of physical activity, most of the students evaluated showed a high level of physical activity. Possibly in this case, the strict contents related to human movement, which the academic training in Physical Education presents, are the cause of the high level of physical activity observed in the population analysed (Aidoud, Elahcene, Bravo, & Ugartemendia, 2021; Stranges, 2019). By the same assumption, the contrast of the marked sedentary lifestyle of Algerian university students could be seen (Abbes & Bereksi-Reguig, 2016; Moussa, Belkadi, Benhammou, Dairi, & Benbernou, 2025).

The study revealed that the canteens available in the educational establishments where the students studied do not offer healthy alternatives, which suggests that the pattern of food selection is similar to that outside the establishments (Boudaoud, Karoune, Adjali, & Dahel, 2019) . However, the eating behaviours of the students were mostly healthy, with adequate minimum daily intakes, breakfast, lunch, and avoiding prolonged fasting (Saker, Merzouk, Merzouk, Ahmed, & Narce, 2011).

The level of physical activity among the students evaluated was high, with an average of 5 sessions per week which is in accordance with (Di Noia, 2010; Reiner, Niermann, Jekauc, & Woll, 2013; Nwankwo-Ezika, 2020; Manar, Adel, Lalia, & Saddak, 2023) studies . The present study suggests that the high level of physical activity observed in the population analysed may be due to the strict contents related to human movement presented in the academic training in Physical Education (Golubeva, Martinov, & Nazymok, 2022; Mokémiabéka et al., 2022).

However, the study also revealed poor nutrition among the students, with non-compliance of the quantity and variety of protein (animal-plant) and fats (animal-plant) in the meals distributed in the university restaurant with the recommended standards. The quantity of carbohydrates in the meals was also found to be non-compliant. This poor nutrition can have a negative impact on physical performance and academic learning abilities. Good learning is associated with a balanced diet, which affects learning abilities and memory capacity.

CONCLUSION

In conclusion, the study found that the population evaluated had a high level of physical activity but poor nutrition. The canteens available in educational establishments do not offer healthy alternatives, and the meals distributed do not comply with the recommended standards. It is essential to improve the nutrition of students to enhance their physical and academic performance. Nutrition education should be provided to students to enable them to make healthier food choices. Moreover, physical education should be accompanied by healthy meal plans to achieve physical education and sports objectives.

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