

The effect of physical activity on body composition: a study of athletic and non-athletic students

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Abstract:

This study analyzes the influence of physical activity on body composition among students - a group particularly susceptible to sedentary behavior. As health problems related to physical inactivity continue to rise globally, this study highlights the benefits of an active lifestyle for physical and metabolic health. By comparing athletic and non-athletic students, it improves understanding of how physical activity affects body parameters and offers important insights for public health initiatives and educational programs. The research is based on the hypothesis that athletic students possess healthier body composition and higher metabolic activity than their non-athletic peers. The research methods used included analysis of specialized literature, statistical-mathematical techniques, graphical representation, and tabular presentation. Data processing was performed using JASP software, a statistical analysis tool with a user-friendly interface that facilitates advanced statistical analyses and data visualization. The study involved 16 female and 32 male athletic students (registered with sports clubs) and 16 female and 17 male non-athletic students (not participating in organized sports) enrolled in undergraduate programs at the National University of Science and Technology Politehnica Bucharest, Romania, Pitești University Center, Faculty of Sciences, Physical Education and Informatics. The athletic female and male students maintained stable body weight, while non-athletic students experienced significant weight gains, especially among females. Male athletes preserved lean body mass, with female athletes showing a slight increase, whereas non-athletic students had no significant changes. Female athletes exhibited a clear reduction in body fat, highlighting the benefits of physical activity, while non-athletic students showed no significant fat changes. Physical activity appears to limit body fat accumulation and promote metabolic health. Additionally, non-athletic students, particularly females, showed a significant decrease in hydration levels, indicating a possible decline in overall health. Athletic students maintained more stable body weight than non-athletic peers, demonstrating that physical activity prevents weight gain. Participation in sports preserved muscle mass, while inactivity among non-athletic students contributed to its decline. Those involved in organized sports experienced greater body stability by retaining muscle mass and avoiding fat gain. In contrast, non-active students showed increased fat accumulation and muscle loss, confirming that physical inactivity adversely affects overall health.

Keywords: sedentary lifestyle, muscle mass, body fat, hydration, health

Introduction

Physical activity, defined as bodily movement generated by skeletal muscles that leads to energy expenditure, improves physical, emotional, intellectual, and social well-being. It also plays a key role in maintaining body weight within healthy limits. Despite these benefits, many students lack physical activity in their daily lives owing to various factors such as time constraints, low motivation, convenience, physical discomfort, professional duties, family responsibilities, and limited financial resources.

Physical activity should be an essential part of everyone's life to foster healthy physical and mental development and to prevent various diseases (Willwéber & Čillik, 2017). Every day, we encounter numerous health-related news and messages that describe the condition of our bodies - some encouraging, others discouraging, and many confusing or contradictory. Often, we accept these messages without question. Even well-educated, health-conscious, informed, cautious, and skeptical individuals can be easily influenced. In such an environment, it becomes difficult to distinguish fact from fiction, making it challenging to determine what is truly beneficial or harmful to our health - especially when the advice comes from individuals who appear highly intelligent and impartial (Lavie & Loberg, 2016).

Sedentary behavior in young people contributes to increased body fat, decreased muscle mass, and a slower metabolic rate (Pavlidou et al., 2024; Izziatut et al., 2022; Syamsudin et al., 2021). Physical inactivity among youth results in similar effects, including higher body fat percentages, reduced muscle mass, and metabolic decline (Joshi et al., 2016; Botelho et al., 2013). Additionally, many students have irregular eating habits: some occasionally eat at the university cafeteria, but often skip meals owing to tight class schedules or

opt for fast food, which is typically very high in calories. This irregular eating pattern, combined with physical inactivity and consumption of calorie-dense foods and drinks, contributes to weight gain.

Healthy eating involves consuming a variety of foods in moderate amounts, distributed throughout the day as three main meals and 1-2 snacks. To maintain a healthy diet, small amounts of simple carbohydrates (such as refined sweets) should be consumed; daily salt intake should not exceed 5 g; adequate hydration is essential; fat consumption - particularly saturated fats - should be limited; and the diet should include sufficient fresh cereals, vegetables, and fruits (Butnariu, 2017).

Obesity is a major risk factor for chronic diseases. Policymakers and healthcare professionals should recognize the dramatic increase in obesity and its related complications to help prevent associated health risks (Abiri, B. et al., 2023). Overweight and obesity remain leading contributors to non-communicable diseases and their associated morbidity and mortality (Atsu, P. et al., 2024). This complex condition arises from disrupted energy homeostasis among various organs (Lu, W. et al., 2024) and stems from an imbalance between energy intake and expenditure. Changes in components of energy intake - such as satiation, postprandial satiety, and emotional eating - as well as variations in energy expenditure, have been associated with obesity and are collectively referred to as obesity phenotypes (Ghusn, W., 2024). Addressing these factors is essential for the effective prevention and management of obesity and its related health complications. Owing to the high prevalence of overweight and obesity alongside common depressive symptoms, there is a pressing need for accessible, low-threshold care approaches that focus on improving mental health in this population. Internet- and mobile-based interventions (IMIs) offer an innovative, complementary treatment option. This review systematically examines IMIs designed to improve mental health among individuals with overweight or obesity (Schladitz, K. et al., 2024). Additionally, universal upstream public policies targeting the entire population function by changing environmental and structural factors that promote obesity. These policies typically require minimal individual effort to change dietary behaviors or physical activity, making them effective tools for obesity prevention (Vandevijvere, S. et al., 2023). Medical nutrition therapy is a fundamental component of obesity treatment, alongside other essential factors such as physical activity, exercise, sleep, and stress management. Diets high in energy (calories) can adversely affect health in multiple ways, including gastrointestinal issues such as constipation, diarrhea, reflux, and acid peptic disorders, as well as metabolic disturbances such as hypertension, metabolic dysfunction-associated steatotic liver disease, overweight, obesity, prediabetes, diabetes, and dyslipidemia (Chávez-Manzanera et al., 2024).

In general, people are unique, and it is important to understand and respect these differences. Individuals vary in many aspects, including lifestyle, education, mindset, communication style, preferences, desires, customs, culture, traditions, and language. No two people are exactly alike, and even twins show considerable differences based on personal experience. This diversity also applies to how people respond to having a body weight above the ideal. Some act promptly after gaining just 2–3 kg, while others delay any action despite being substantially overweight by 15–20 kg or more (Butnariu, 2022).

A variety of assessment and functional evaluation methods are used to identify the type and severity of obesity. Using appropriate standardized measurement techniques ensures a strong theoretical basis for accurate diagnosis, monitoring treatment progress, and interpreting outcomes (Balint, 2006).

While body mass index (BMI) is helpful for categorizing populations by weight, it is inadequate for assessing individual health risks because it does not account for muscle mass, body fat percentage, or fat distribution.

Although international interest in classifying health status based on adiposity is growing, there are currently no universally accepted published ranges for percentage body fat. Various approaches - such as empirically determined limits, population percentiles, and z-scores - have been proposed to establish guidelines for percentage body fat, but each method has limitations (Gallagher et al., 2000). Body composition research, a field in human biology, encompasses three interconnected areas: the levels and organizational principles of body composition, measurement techniques, and the biological factors that affect body composition (Wang et al., 1992). The relationship between BMI and body fat percentage varies considerably depending on age, gender, and ethnic group (Deurenberg et al., 1998; Gallagher et al., 2000). It is well established that regular physical activity is the key factor in improving body composition (Šliž et al., 2023; Kolokoltsev et al., 2022; D'Isanto et al., 2019). Such improvement is attained through the consistent and systematic practice of physical exercises (Fett et al., 2009; Park et al., 2003).

For the human body to function properly, adequate hydration is essential. Without sufficient water, organs cannot operate effectively, resulting in dehydration. Proper hydration helps regulate body temperature, facilitates nutrient transport, supports optimal heart function, maintains immune system health, and ensures the kidneys work correctly. For athletes, maintaining adequate hydration is essential because it enhances cardiovascular performance, preserves electrolyte balance, lowers the risk of muscle cramps and injuries, and improves mental focus and concentration.

Popkin et al. (2010) provided a comprehensive overview of water's role in bodily functions, daily water needs, and dehydration signs, while also examining how dehydration impacts cognitive and physical performance. Armstrong (2007) reviewed various hydration assessment methods, including urine analysis, serum osmolality, and body weight changes. Although no single "gold standard" exists for evaluating hydration status,

Kavouras (2002) suggested that body weight changes alongside urine osmolality, specific gravity, conductivity, and color were among the most commonly used and reliable indicators.

Research Hypothesis: Female and male student-athletes have healthier body composition and more active metabolism compared to non-athlete students.

Research Objectives:

- to identify differences in body composition between athletic and non-athletic students.
- to correlate measured body parameters with physical activity levels.
- to evaluate the impact of physical activity on basal metabolic rate and hydration status.

Materials and methods

Research subjects:

The study included 16 female and 32 male student-athletes registered with sports clubs, along with 16 female and 17 male non-athlete students who did not participate in organized sports. All participants were enrolled in undergraduate programs at the National University of Science and Technology Politehnica Bucharest, Romania, Pitești University Center, Faculty of Sciences, Physical Education and Informatics. The experiment consisted of two phases: initial testing in October 2023 and final testing in June 2024. Participants were informed about the study's procedures, requirements, benefits, and risks, and all provided voluntary consent to participate.

Research Design

The research used several methods, including specialized literature analysis, statistical and mathematical techniques, as well as graphical and tabular presentations.

During the study, body composition parameters were assessed using the Tanita scale, a sophisticated device designed for this purpose. It uses bioelectrical impedance analysis (BIA) technology to measure body weight, body fat percentage, muscle mass, hydration level, bone mass, and metabolic age.

The Tanita scale is widely used both personally and professionally, particularly favored by athletes and health professionals for tracking progress and overall health. To ensure measurement accuracy, participants stood barefoot on the platform and removed any metallic items or wristwatches during the BIA assessment.

Statistical Analysis

Data processing was performed using JASP software, a user-friendly program that enables advanced statistical analyses and effective data visualization. The data entered into JASP were collected using the Tanita scale. Statistical analysis included the Shapiro–Wilk test, Student's t-test, and Wilcoxon test.

Results

A detailed analysis of the research results involves interpreting changes between the initial and final measurements for each group - male athletic students (MA), male non-athletic students (MNA), female athletic students (FA), and female non-athletic students (FNA) - as well as assessing differences between athletes and non-athletes.

Final Body Weight Compared to Initial Body Weight:

Students engaged in organized sports (MA, FA):

- *Student's t-test:*
 - MA: $t = 0.127$, $p = 0.9$ – no statistically significant differences were observed between the initial and final measurements.
 - FA: $t = -0.258$, $p = 0.8$ – no statistically significant differences were recorded.
 - *Wilcoxon test:*
 - MA: $z = 0.195$, $p = 0.853$ – no significant changes in body weight were recorded.
 - FA: $z = -0.028$, $p = 1$ – no significant changes in body weight were observed.
- Students not engaged in organized sports (MNA, FNA):
- *Student's t-test:*
 - MNA: $t = 2.432$, $p = 0.027$ – statistically significant differences were observed, indicating a significant increase in body weight.
 - FNA: $t = 4.769$, $p < 0.001$ – the increase in body weight was statistically significant.
 - *Wilcoxon test:*
 - MNA: $z = 2.083$, $p = 0.039$ – the results confirm a significant increase in body weight.
 - FNA: $z = 3.103$, $p = 0.002$ – the data confirm a statistically significant gain in body weight.

Body weight values remained similar between measurements, indicating stability in most cases. The initial weight was consistent across measurement phases, suggesting that participants focused on maintaining their weight. Both MA and FA exhibited consistent body weight, with minimal variations (less than 0.2 kg) between the initial and final assessments.

In stark contrast to the stable body weight observed in athletic students, their non-athletic counterparts showed a modest upward trend. MNA and FNA each gained approximately 1 kg. Notably, the FNA group's weight increased from 54.5 to 56 kg, highlighting that this weight gain was more pronounced in females.

Final Lean Mass Compared to Initial Lean Mass

Students engaged in organized sports (MA, FA):

- *Student's t-test:*
 - MA: $t = 0.648, p = 0.522$ – no statistically significant changes were observed.
 - FA: $t = 1.838, p = 0.086$ – a slight upward trend was noted, though not statistically significant.
 - *Wilcoxon test:*
 - MA: $z = 0.935, p = 0.354$ – no significant changes in lean mass were identified.
 - FA: $z = 1.732, p = 0.087$ – a slight trend toward increased lean mass was observed.
- Students not engaged in organized sports (MNA, FNA):
- *Student's t-test:*
 - MNA: $t = -1.155, p = 0.265$ – no statistically significant differences were observed.
 - FNA: $t = 1.23, p = 0.238$ – no significant changes were detected.
 - *Wilcoxon test:*
 - MNA: $z = -0.876, p = 0.394$ – no significant differences in lean mass were recorded.
 - FNA: $z = 1.335, p = 0.19$ – no statistically significant changes were observed.

Among athletic students, both males and females showed a slight increase in lean mass (0.1–0.3 kg), suggesting muscle development. In contrast, non-athletic students experienced a decrease in lean mass (0.2–1 kg), indicating a potential loss of muscle tissue. While both groups generally maintained stable values in the most frequent measurements, MNA and FNA had slightly lower final values, which may reflect muscle mass decline.

Final Body Fat Compared to Initial Body Fat

Students engaged in organized sports (MA, FA):

- *Student's t-test:*
 - MA: $t = -0.648, p = 0.522$ – no statistically significant changes in body fat were observed.
 - FA: $t = -2.113, p = 0.052$ – a trend toward a significant decrease in body fat was identified.
 - *Wilcoxon test:*
 - MA: $z = -0.898, p = 0.374$ – no significant changes were identified.
 - FA: $z = -1.883, p = 0.063$ – a trend toward a significant reduction in body fat was observed.
- Students not engaged in organized sports (MNA, FNA):
- *Student's t-test:*
 - MNA: $t = 1.155, p = 0.265$ – no significant changes in body fat were observed.
 - FNA: $t = -0.674, p = 0.51$ – no statistically significant differences were detected.
 - *Wilcoxon test:*
 - MNA: $z = 0.876, p = 0.394$ – no significant changes were identified.
 - FNA: $z = -0.795, p = 0.442$ – no statistically significant differences were observed.

Body fat levels slightly decreased among athletic students (MA: -0.1%, FA: -0.35%), indicating that regular physical activity helped maintain a low fat percentage. Both medians and means remained stable, with low standard deviations, suggesting effective management of body fat composition. Athletic students demonstrated better control of their body composition compared to non-athletic peers, who experienced an increase in fat mass. The increase in average body fat percentage among non-athletes - especially male students (from 12.8% to 13.3%) - indicates fat accumulation likely owing to physical inactivity. Specifically, body fat increased for both male and female non-athletes (MNA: +0.94%, FNA: +0.22%), reflecting a gradual buildup of fat tissue. This increase was more pronounced in male students, suggesting greater susceptibility to fat accumulation and a potential predisposition to obesity.

Final Hydration Compared to Initial Hydration:

Students engaged in organized sports (MA, FA):

To assess changes in hydration status from the beginning to the end of the observation period, statistical analyses were performed using both the paired Student's *t*-test and the non-parametric Wilcoxon signed-rank test.

- *Student's t-test:*
 - Among MA, the *t*-test yielded $t = 1.234$ with a significance level of $p = 0.226$, indicating no statistically significant difference between initial and final hydration levels.
 - Similarly, for FA, the *t*-value was 0.732 with $p = 0.475$, indicating no significant changes over time.
 - The *Wilcoxon test* supported these findings:
 - For MA, the test statistic was $z = 1.421$ with $p = 0.158$, suggesting no significant changes.
 - For FA, $z = 0.491$ with $p = 0.641$, confirming the absence of a significant change in hydration.
- Students not engaged in organized sports (MNA, FNA):
- In contrast, students who did not participate in organized sports exhibited a different trend.
- *Student's t-test:*
 - The paired *t*-test for MNA showed a decrease in hydration levels, with $t = -1.76$ and $p = 0.097$, indicating a tendency toward reduction that did not reach statistical significance.

- For FNA, the decline was more pronounced, with $t = -2.346$ and $p = 0.033$, indicating a statistically significant decrease in hydration status.
 - The Wilcoxon test confirmed these results:
- Among MNA, $z = -1.681$ and $p = 0.097$, confirming a trend toward lower hydration, albeit not significant.
- For FNA, $z = -1.913$ with $p = 0.058$, indicating a near-significant reduction, approaching statistical significance.

Hydration levels remained relatively stable among all participants, with only minimal variations (approximately $\pm 0.2\%$). Athletes consistently showed higher mean hydration values compared to non-athletes. The data suggest that short-term physical activity has a limited impact on hydration variability. Measurements revealed stable and consistent values, with no statistically significant fluctuations. Minor decreases in both mean and median values were observed, potentially indicating an imbalance in lifestyle habits. Hydration levels remained constant among athletic students, while non-athletic students showed a slight decrease.

Data presented in Table 1 show that among students involved in organized sports (MA, FA), lean body mass remained stable with minor fluctuations, while both means and medians slightly increased, suggesting muscle mass maintenance. In contrast, a slight decrease in lean mass was observed among students not engaged in organized sports (MNA, FNA), supporting the hypothesis of reduced metabolically active tissue in this group. Thus, regular physical activity appears to support the preservation of muscle mass, whereas its absence is associated with a decline in lean body mass.

The median was used as a measure of central tendency to better represent the data distribution, particularly owing to the non-normal distribution and the presence of outliers. Table 1 shows the initial and final median values for each group: MA - initial 75.35, final 75.25; FA - initial 61.4, final 60.5; MNA - initial 76, final 77.5; FNA - initial 58.2, final 59.25.

The close similarity between initial and final medians among athletic students confirms effective control over body weight. In contrast, the slight increase in median values among non-athletic students may suggest moderate weight gain.

Among the MA, the mean body weight was 77.29 kg at the initial measurement and 77.32 kg at the final one. For FA, the mean weight was 63.58 kg initially and 63.52 kg at the end of the study period. These minimal changes indicate a balanced relationship between energy intake and physical activity.

Among non-athletic students, MNA showed an increase in mean body weight from 79.11 kg (initial) to 80.48 kg (final), while FNA recorded an increase from 60.7 to 61.88 kg. These moderate yet significant gains suggest a possible caloric surplus over the study period.

Table 1. Descriptive statistics – mode, median, and mean

	Mode				Median				Mean			
	MA	MNA	FA	FNA	MA	MNA	FA	FNA	MA	MNA	FA	FNA
IW	75.4	54.7	52	54.5	75.35	76	61.4	58.2	77.29	79.11	63.58	60.71
FW	75.3	54	52	56	75.25	77.5	60.5	59.25	77.32	80.48	63.52	61.88
ILM	62.1	57.8	38	32.8	62.10	60.4	42.7	39.7	63.06	62.99	44	40.03
FLM	62.3	57	41	37	62.30	58.6	42.9	40	63.17	62.56	44.25	40.31
ILM	9.52	3.84	28	28.8	9.52	11.93	27.4	16.76	10.87	12.85	28.21	18.55
FLM	9.4	2.94	28	9.13	9.40	11.23	27.4	15.88	10.77	13.28	27.98	18.37
IH	62.4	58.4	52	47.5	62.35	60.5	54	52.55	62.07	60.84	54.54	52.08
FH	62.2	65	55	56	62.15	58.6	54.5	52	62.32	60.18	54.68	51.58

Legend for Tables 1–5: IW – Initial weight; FW – Final weight; ILM – Initial lean mass; FLM – Final lean mass; IBF – Initial body fat; FBF – Final body fat; IH – Initial hydration; FH – Final hydration; MA – Male athletic students; MNA – Male non-athletic students; FA – Female athletic students; FNA – Female non-athletic students.

Table 2 shows that students involved in organized sports demonstrated low standard deviations (MA: 13.43; FA: 10.71), indicating limited variability in their groups. In contrast, non-athletic students showed greater inter-individual variability in body weight, with higher standard deviations (MNA: 21.36; FNA: 11.19). The particularly substantial variation observed in MNA may reflect diverse dietary habits and lifestyle patterns.

The Shapiro–Wilk test is a statistical method used to assess whether a dataset follows a normal distribution. It produces a W statistic (with values close to 1 indicating normality) and a p -value. A p -value below the chosen significance level (typically 0.05) leads to the rejection of the null hypothesis of normality. The test is particularly effective for detecting non-normality, especially in small samples. According to Table 2, the Shapiro–Wilk test results indicate that not all parameters exhibited perfectly normal distributions, as evidenced by p -values below 0.05 in certain groups.

Table 2. Descriptive statistics – standard deviation, Shapiro–Wilk, and minimum

	Std. Deviation				Shapiro Wilk				Minimum			
	MA	MNA	FA	FNA	MA	MNA	FA	FNA	MA	MNA	FA	FNA
IW	13.85	20.92	10.84	10.76	0.916	0.87	0.001	0.927	55	54.7	52.4	4.7
FW	13.43	21.36	10.71	11.19	0.927	0.878	0.001	0.933	55.2	54	52	44
ILM	7.874	11.71	5.24	4.657	0.978	0.901	0.075	0.934	48.5	45.6	37.8	32.8
FLM	7.715	11.77	5.53	4.784	0.976	0.901	0.036	0.972	49.1	47	38	32
IBF	6.797	9.356	11.77	6.778	0.804	0.858	0.049	0.919	3.03	3.84	9.1	9.13
FBF	6.866	9.675	11.72	6.891	0.812	0.884	0.047	0.925	2.43	2.94	8.9	9.13
IH	5.496	5.874	5.133	4.307	0.966	0.934	0.323	0.921	49.2	50.6	47.3	45.7
FH	5.393	6.221	5.175	4.139	0.977	0.935	0.377	0.953	48.5	49.2	47.1	44.1

Data presented in Table 3 show a low coefficient of variation among students engaged in organized sports (approximately 0.17), indicating a uniform data distribution in these groups. In contrast, non-athletic students exhibit higher coefficients of variation - approximately 0.26 for MNA and 0.18 for FNA - suggesting greater data dispersion. The absence of regular physical activity appears to increase variability, reflecting disparities in body composition. The lower coefficient of variation observed in athletes indicates greater stability in body composition parameters.

Table 3. Descriptive statistics – maximum and coefficient of variation

	Maximum				Coefficient of variation			
	MA	MNA	FA	FNA	MA	MNA	FA	FNA
IW	120.5	138.8	94.3	78	0.179	0.264	0.171	0.177
FW	119	140	93	80	0.174	0.265	0.169	0.181
ILM	81.6	95.2	55.9	46.7	0.125	0.186	0.119	0.116
FLM	80.5	94.2	57	48.1	0.122	0.188	0.125	0.119
IBF	34.7	38.73	619	28.78	0.625	0.728	0.417	0.365
FBF	35.8	39.73	615	30.48	0.638	0.728	0.419	0.375
IH	74.9	69.4	64.6	60.1	0.089	0.097	0.094	0.083
FH	75.1	70.12	65	58.2	0.087	0.103	0.095	0.080

Tables 4 and 5 show the results of the *t*-test and the Wilcoxon signed-rank test. The paired *t*-test compares the means of two related groups (e.g., athletic and non-athletic students) to determine whether a statistically significant difference exists between them. This test assumes that the differences between paired observations are normally distributed.

The Wilcoxon signed-rank test is a non-parametric alternative to the paired *t*-test. It assesses whether the median difference between paired observations is zero, making it suitable when the normality assumption required by the *t*-test is not met. Both tests are commonly used to analyze dependent or repeated measurements.

Table 4. Paired samples t-test and Wilcoxon test

Measure 2	Measure 1	Test	Statistic				Z			
			MA	MNA	FA	FNA	MA	MNA	FA	FNA
FW	IW	Student	0.127	2.432	-0.258	4.769				
		Wilcoxon	242	120.5	59.5	128	0.195	2.083	-0.028	3.103
LFM	ILM	Student	0.648	-1.155	1.838	1.23				
		Wilcoxon	314	58	1.015	83.5	0.935	-0.876	1.732	1.335
FBF	IBF	Student	-0.648	1.155	-2.113	-0.674				
		Wilcoxon	216	95	22.5	46	-0.898	0.876	-1.883	-0.795
FH	IH	Student	1.234	-1.76	0.732	-2.346				
		Wilcoxon	340	41	77.5	31	1.421	-1.681	0.491	-1.913

Table 5. Paired samples t-test and Wilcoxon test

Measure 2	Measure 1	Test	Number of students				p			
			MA	MNA	FA	FNA	MA	MNA	FA	FNA
FW	IW	Student	32	17	16	16	0.9	0.027	0.8	≤ 0.01
		Wilcoxon					0.853	0.039	1	0.002
LFM	ILM	Student	32	17	16	16	0.522	0.265	0.086	0.238
		Wilcoxon					0.354	0.394	0.087	0.19
FBF	IBF	Student	32	17	16	16	0.522	0.265	0.052	0.51
		Wilcoxon					0.374	0.394	0.063	0.442
FH	IH	Student	32	17	16	16	0.226	0.097	0.475	0.033
		Wilcoxon					0.158	0.097	0.641	0.058

Discussion

Analysis of the results showed that MA and FA maintained stable body weight, lean mass, body fat percentage, and hydration levels. Their low standard deviations and coefficients of variation indicate effective body composition control, likely owing to regular physical activity. In contrast, non-athletic students recorded slight increases in body weight and body fat, alongside decreases in lean mass. The higher variability in this group suggests inconsistent lifestyle and dietary habits.

Athletic students consistently maintain optimal body composition and overall health. In contrast, non-athletic individuals are at a higher risk for increased body fat accumulation and decreased muscle mass, indicating a potential decline in general health. These findings highlight the clear benefits of physical activity because it contributes to healthy weight maintenance and fat prevention. Thus, students involved in organized sports demonstrate superior body composition control compared to their non-athletic counterparts.

Sports nutrition (SN) is essential in helping athletes achieve peak performance, reduce sport-related injuries, extend career longevity, and improve overall health (Jayawardena et al., 2023).

To promote healthy eating habits among university students, this study's findings highlight the necessity of implementing nutritional education programs. These programs should emphasize reducing fat and caloric intake while promoting increased consumption of dietary fiber, complex carbohydrates, fruits, and vegetables. Such practices are essential for improving physical appearance through effective weight management. Students also need to develop healthy eating behaviors that extend beyond food choices to include portion size, eating methods, and meal timing.

The significant changes in body weight, body fat ratio, and body mass index observed in the experimental group are believed to result from exercise participation. An appropriate exercise program combined with proper nutrition may contribute to physical fitness across all age groups, and the continuity of physical activity can influence these parameters (Apaydin & Polat, 2022).

A multifaceted approach to obesity management is essential, combining exercise, nutrition, and behavioral strategies to optimize health outcomes (Sonchan et al., 2025).

Aerobic exercise is one of the most widely known healthy physical activities worldwide, especially for obese patients. It is also considered the most effective treatment for obesity because it burns calories and lowers blood cholesterol levels (Hassan et al., 2023).

Tiernan and Garrett (2024) performed a study on the nutrition knowledge, attitudes, and dietary behaviors of Irish adolescent athletes. The main finding was that the nutrition knowledge - particularly sports nutrition knowledge - of these athletes was deficient, regardless of their sex or sport.

Research indicates that muscle mass contains a high percentage of water, meaning individuals with greater muscle mass generally have higher relative hydration levels. Armstrong's studies (2007) support the idea that optimal hydration is essential for metabolic functions and physical performance, demonstrating a direct proportionality to muscle mass.

Body fat contains substantially less water than muscle tissue, which helps explain why individuals with a high body fat percentage often exhibit lower hydration levels.

Our findings on hydration revealed that, despite awareness of various rehydration strategies and the signs and adverse effects of dehydration, many participants experienced moderate to severe dehydration symptoms (Jayawardena et al., 2024).

The human body largely consists of intracellular and extracellular fluids. Maintaining their balance is essential because any imbalance can result in weakness, lack of focus, and difficulty concentrating (Nuridin et al., 2024).

Studies and expert opinions suggest that no single parameter alone is sufficiently accurate to evaluate health status and body composition. Combining multiple measurements - especially for assessing body fat percentage and hydration levels - offers a more comprehensive and practical understanding. This integrated approach is more effective for disease prevention and long-term health maintenance.

Conclusions

Athletic students exhibited more stable body weight compared to their non-athletic peers, confirming that physical activity helps prevent weight gain. Regular participation in sports also preserved muscle mass, while the lack of physical activity among non-athletic students contributed to its decline.

While both MA and FA maintained stable body weight throughout the study, non-athletic students experienced significant increases, with this trend being more pronounced among females.

MA maintained stable lean mass, while FA showed a slight tendency to increase. Non-athletic students, both male and female, did not exhibit significant changes in lean mass.

FA showed a clear trend toward reduced body fat, highlighting the positive impact of sport on body composition. No significant changes were observed among non-athletes. Overall, regular physical activity appears to reduce fat accumulation and promote better metabolic health.

Students not engaged in physical activity, especially female students, exhibited a statistically significant decrease in hydration levels, suggesting a potential decline in overall health status.

Students who engaged in organized sports demonstrated greater bodily stability by maintaining lean mass and preventing fat accumulation. In contrast, those not participating in organized physical activity showed a greater tendency toward increased body fat and decreased muscle mass, confirming the negative effects of physical inactivity on overall health.

Students should be encouraged to engage in regular physical activity to maintain a healthy body composition and prevent the negative effects of a sedentary lifestyle. Additionally, offering optional nutrition education courses is recommended because simply monitoring body weight and keeping it stable does not guarantee good physical health. Body weight can remain unchanged even with a loss of muscle mass and a gain in fat mass, which changes body density despite stable weight.

Conflicts of interest

The author declares no potential conflicts of interest related to the research authorship and/or publication of this article.

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