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Article

The Assessment of Motor Capabilities in University Students from Health and Non-Health Study Programs Through Body Composition Analysis

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Abstract: Motor skills in students can be developed or improved through regular physical activity such as walking in nature, Nordic walking, hiking, cycling and swimming. This study aimed to examine the relationship between motor skills and various anthropometric and health-related factors, and to appraise any differences in motor performance and body mass index (BMI) on a sample of university students from Croatia. A total of 122 students (73 of them in health programs and 49 in non-health programs) aged 18 to 44 years participated in the study. Motor abilities were evaluated using standardized motor tests, while body composition was assessed via bioelectrical impedance analysis, which measured fat tissue, muscle and bone mass, metabolic age, degree of obesity, total body water, and BMI. While the groups were similar in terms of BMI and weight, students in non-health-related study programs had significantly higher values across a wide array of detailed body composition measures, particularly related to fat and muscle mass. Significant negative correlations were observed between body fat percentage and trunk lift performance ($r=-0.547$, $p<0.01$), as well as between metabolic age and trunk lift performance ($r=-0.444$, $p<0.01$) in health students. In non-health students, the strongest negative correlation was found between body fat percentage and flexibility ($r=-0.467$, $p<0.01$). Multiple linear regression analysis revealed that higher muscle mass was a positive predictor of motor performance ($\beta=0.565$, $p<0.001$), while higher fat mass and metabolic age were significant negative predictors ($\beta=-0.858$, $p=0.049$; $\beta=-0.911$, $p=0.003$, respectively). Students with excessive body weight consistently exhibited higher fat mass, metabolic age, as well as poorer motor outcomes. These findings underscore the impact of body composition on motor performance, particularly strength and flexibility, and highlight the need for targeted preventive strategies among university students. The study supports the implementation of early interventions promoting physical activity and healthy body composition to preserve motor abilities and long-term functional health in this critical age group – especially since lifestyle habits formed during university years tend to persist into adulthood.

Keywords: students; motor ability; body analysis; body mass index; physical activity

1. Introduction

Motor skills, physical fitness and body composition in young adults [1] are key indicators of general health and well-being [2], and their dynamics throughout life can provide valuable information about the impact of social, environmental and biological factors on human health. Biological adaptability enables the human organism to acquire motor knowledge and skills, which in turn build and refine its motor abilities rresponsible for the realization of all types of movement and motor tasks. The basic characteristic of motor skills is the correct and efficient execution of

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movements and/or the voluntary maintenance of a desired position under the influence of certain external forces and factors [3,4]. They are measurable and conditioned by genetic potential, and also under the influence of various physiological and anatomical factors, morphological characteristics, cognitive abilities, motivation and energy capacities [4]. Physical exercise can significantly influence the development and maintenance of the level of motor skills [5,6]. Some motor skills can be influenced to a greater extent than others depending on the coefficient of innateness, gender and age [7,8]. Peak motor skills are most pronounced between the ages of 20 and 25, with the exception of flexibility, which peaks in childhood [4]. In young adults, motor skills are more strongly associated with body composition than with height or weight [1]. Over the past two decades, significant changes have been observed in the lifestyles of young adults, including a decrease in physical activity levels, which is reflected in poorer physical performance, as well as an increase in body fat [9] and adverse changes in physical activity [10]. Although many young adults report maintaining similar levels of physical activity as in the past, research shows that there is a decrease in physical performance [11–14], an increase in body fat percentage, and a decrease in muscle mass [14], speed, and strength [15]. These negative changes can have long-term health consequences; therefore, it is crucial to understand how these components develop over time.

Physical activity is essential for improving body composition and physical performance, regardless of gender, age, weight, or maturity status [16]. Consequently, university students represent a particularly relevant population for examining motor skills in relation to body composition, as this life stage is marked by significant physiological, behavioral and lifestyle transitions that can influence both parameters. Starting university is a demanding period in the life of every student [17]. In addition to offering new opportunities, freedom and independence, studying also brings with it a high level of responsibility. The change in environment and obligations during studying are often associated with a reduced level of physical activity and an increase in a sedentary lifestyle [18,19], which consequently affects the status of motor skills and body composition. Maintaining flexibility and strength in this period of life are one of the important physical predictors of quality of life in adulthood and old age [20]. Body composition assessment is carried out using anthropometric measurements and bioelectrical impedance analysis. Using various formulas, bioelectrical impedance analysis calculates the percentage of fat and lean components (water content, skeletal and smooth muscle mass, and bone mass) in the human body [21–23]. The above components have a great influence on strength and flexibility [24]. A higher proportion of lean mass, especially muscle tissue, is directly related to greater muscle strength. Through anthropometric data and motor ability tests, where variables are related to fat and adipose tissue, and muscle and bone development, physical activity, or physical fitness tests, show a significant difference [24].

The body composition of athletes differs in significantly higher amounts of total body water, free mass, skeletal muscle and a lower percentage of fat compared to healthy physically inactive individuals [25]. Students with a higher proportion of muscle mass show better performance in strength exercises [6]. A higher percentage of fat tissue can limit strength because it creates additional load on the body without contributing to force production. In obese individuals, strength can be reduced due to less functional muscle mass and an increased risk of injury [26]. Research shows that a higher percentage of fat tissue, especially around joints such as hips and knees, can limit flexibility due to mechanical restrictions in movement. Excessive fat in these areas can physically block the full range of motion, making it difficult to perform certain exercises or movements with full efficiency [27,28]. On the other hand, muscle mass plays a pivotal role in supporting flexibility, provided that the muscles are properly stretched and functionally strong. If the musculature is too tight or overtrained without adequate stretching (as can happen in strength-focused athletes), this can reduce range of motion [29]. Proper hydration is essential for maintaining muscle and connective tissue elasticity, which supports overall muscle and tendon flexibility and prevents injury [30]. Thus, while excess body fat can limit flexibility by blocking joint movement, maintaining a healthy balance of muscle mass and proper hydration can support and improve flexibility.

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The aim of the study is to examine the relationship between body mass index (BMI), muscle mass and fat mass with muscle strength and flexibility in university students, as well as compare students enrolled in health study programs and those in non-health study programs. The study also analyzes how different components of body composition (e.g., muscle mass, fat tissue) affect muscle strength performance and range of motion. We also aimed to assess the role of body mass and its components in maintaining functional mobility, with a special emphasis on preventing biomechanical limitations and improving physical fitness.

2. Materials and Methods

2.1. Body Composition Analysis

Body composition analysis was carried out using the medically certified segmental body composition analyzer TANITA MC-780MA (TANITA Corporation, Tokyo, Japan). Measurements were conducted in either the "Standard" or "Athlete" mode depending on participants' self-reported activity levels. The analyzer automatically calibrated itself before each individual measurement. It was stationed in a stable location throughout the study, and in case of relocation to a new environment with a temperature difference exceeding 20 °C, a minimum waiting period of two hours was observed to allow proper acclimatization.

The device measured a range of parameters including body weight, fat mass (expressed as a percentage), muscle mass (kg), bone mass (kg), metabolic age, degree of obesity (%), total body water (TBW in kg and %), basal metabolic rate (BMR in kcal and kJ), and body mass index (BMI). All measurements were performed barefoot, with participants standing upright in a standardized position, and between 10:00 and 13:00 in the day. Participants were required to abstain from heavy meals, alcohol, stimulants (such as coffee or energy drinks), as well as excessive fluid intake prior to measurement. Instructions were provided both orally and in writing 24 hours beforehand. Participants wore light, non-restrictive clothing and removed all metallic accessories.

2.2. Participants and Setting

The study was conducted at the University North, University Center Varaždin (UNIN2), in the Physiotherapy Laboratory 2 (FT2), between October 25, 2023, and May 25, 2024. A convenience sampling approach was employed, whereby participants were recruited from the available student population at the University North who met the inclusion criteria and voluntarily agreed to participate in the study. The final sample included 49 students from non-health-related study programs (Electrical Engineering, Civil Engineering, Multimedia and Mechanical Engineering) and 73 students from the Physiotherapy study program. Participants were aged 18 to 44 years. Those who were older than 44 years, had known illnesses or injuries, or were unable to complete the full set of motor tests were excluded. In total, two participants were removed due to age criteria, and eight physiotherapy students were excluded due to incomplete motor test data related to health conditions.

2.3. Motor Ability Testing

Motor abilities were tested after body composition analysis, with participants in a rested physical state. All tests were explained and demonstrated beforehand by trained and licensed physiotherapists from the Department of Physiotherapy of the University North, ensuring consistency and inter-rater reliability.

The motor ability tests included: flexibility of the shoulder girdle (MFLISK), flexibility of the dominant and non-dominant arm (MFLPRG-D, MFLPRG-N), and trunk flexibility in a wide-leg position (MFLPRR). Speed was evaluated through a hand tapping test (MBFTAP), coordination via lateral step agility (MAGKUS), and repetitive strength using three different tasks: sit-ups from a lying position (MRSPTL), push-ups on the knees (MRSNK), and half-squats (MRPLČ). Measurements were obtained using standard instruments including a centimeter tape and a stopwatch.

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The abbreviations used for motor tests are consistent with those found in established academic resources including textbooks, scientific conference materials and peer-reviewed articles in kinesiology and physiotherapy, and align with international practices for physical fitness assessment.

2.4. Ethics and Data Protection

The study was approved by the Ethics Committee of the University of North (Class: 641-01/24-01/07, number: 2137-0336-07-24-1; date of approval: April 4, 2024). Participation was voluntary and anonymous, and all participants signed written informed consent prior to inclusion. Data privacy was maintained through encryption, and all data were stored securely on the servers of University North. Only authorized researchers had access to participant data. The study was conducted in full compliance with applicable ethical standards, ensuring confidentiality and participant welfare. There were no potential risks identified for participants, and all procedures were non-invasive and well within the scope of standard physiotherapy practice.

2.5. Statistical Analysis

Data analysis included both descriptive and inferential statistical methods. To evaluate differences between the two student groups groups, the Mann-Whitney U test was applied for continuous, non-normally distributed variables (such as body composition indicators), while the chi-square test was used to assess associations between categorical variables. Relationships between variables were assessed using Spearman's rank correlation coefficient (r), ranging from –1 to +1. Multiple linear regression analysis was performed to examine the effect of independent variables on selected outcomes. The Kruskal-Wallis test was used to compare differences between groups, chosen due to its non-parametric nature. Statistical significance was set at an alpha level of 0.05 (two-tailed), representing a 95% confidence interval. All analyses were conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA).

3. Results

A total of 122 respondents participated in the study, of which 73 (59.8%) were health students and 49 (40.2%) were non-health students. According to the gender distribution of the total 122 respondents, 56 (45.9%) were male, while 66 (54.1%) were female. Furthermore, the arithmetic mean of the respondents' age is 20.02 with a standard deviation of 3.946, with the minimum value being 18, while the maximum value is 50.

Using the Mann-Whitney U test, statistically significant differences between health students and non-healths students were found in total fat percentage ($p<0.001$), total fat mass (kg) ($p=0.007$), basal metabolic rate ($p=0.004$), fat-free mass ($p=0.001$), protein muscle mass ($p=0.001$), protein mass percentage ($p<0.001$), skeletal muscle mass (kg) ($p=0.002$), skeletal muscle mass percentage ($p=0.001$), bone mass ($p=0.001$), sarcopenia index ($p<0.001$), total body water percentage ($p<0.001$), total body water (kg) ($p=0.003$), extracellular water ($p=0.010$), ratio of extracellular water to total body water ($p=0.011$), intracellular water ($p=0.002$), ratio of intracellular water to total body water ($p=0.004$), phase angle (bioelectrical impedance) ($p=0.004$), trunk fat percentage ($p=0.001$), trunk fat mass (kg) ($p=0.014$), left arm fat percentage ($p<0.001$), left arm fat mass (kg) ($p=0.003$), left leg fat percentage ($p<0.001$), left leg fat mass (kg) ($p=0.008$), right arm fat percentage ($p<0.001$), right arm fat mass (kg) ($p=0.003$), right leg fat percentage ($p=0.001$), right leg fat mass (kg) ($p=0.013$), trunk protein muscle mass ($p=0.001$), left arm protein muscle mass ($p<0.001$), left leg protein muscle mass ($p=0.002$), right arm protein muscle mass ($p<0.001$), and right leg protein muscle mass ($p=0.002$). In the majority of these indicators, students in non-health-related programs showed higher values, suggesting greater fat and muscle mass distribution compared to their health-studies counterparts.

However, no statistically significant differences were observed in body mass index ($p=0.987$), visceral fat ($p=0.961$), total body weight ($p=0.269$) or metabolic age ($p=0.260$), indicating that overall body size and metabolic age were comparable across both groups. Additionally, a chi-square test

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evaluating the association between study program and body mass index categories showed no statistically significant difference (χ^2=3.003, df=3, p=0.391), suggesting that the distribution of individuals across underweight, normal weight, overweight and obese categories did not differ significantly between students of health and non-health programs.

Both positive and negative correlations were recorded between the observed variables, the highest significant negative correlations were recorded between the indicators: body fat in percentage (TRFATP) and repetitive strength – lifting the body from a lying position (MRSPTL) (r=-0.547; p<0.01), metabolic age (METAAGE) and MRSPTL (r=-0.444; p<0.01) while the highest significant positive correlation was recorded between the indicators:, and body fat in kilograms (TRFATM) (r=0.941; p<0.01 (TRFATM) and METAAGE (r=0.939; p<0.01).

Table 1. Spearman correlation coefficient I (group of health students – 73).

	1	2	3	4	5	6	7	8	9
1. WEIGHT	1.000								
2. TRFATP	.532**	1.000							
3. TRFATM	**.755****	**.941****	1.000						
4. PMM	**.829****	.025	.321**	1.000					
5. METAAGE	.681**	**.897****	**.939****	.274*	1.000				
6. MFLPRR	-.189	-.198	-.225	-.090	-.295*	1.000			
7. MRSPTL	-.004	**-.547****	**-.402****	.351**	**-.444****	.195	1.000		
8. MRSNK	.107	-.503**	-.325**	.486**	-.285*	-.046	.570**	1.000	
9. MRPLČ	.366**	-.109	.047	.544**	-.010	.020	.348**	.353**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

If we look at the significance value for all observed variables, it can be seen that p is less than 0.05, so it can be said, with a confidence level of 95%, that there is a statistically significant difference with respect to the BMI of the subjects. In Table 2, it can be seen that the median value is higher for subjects with a higher BMI value (overweight and obesity).

Table 2. Comparison with respect to the subjects' BMI.

		BMI				p*
		Malnutrition	Normal Weight	Excess Weight	Obesity	
TRFTATP	Median	8.90	19.10	27.30	37.40	<0.001
	Percentile 25	7.30	16.80	25.60	35.80	
	Percentile 75	15.80	23.70	29.70	39.70	
TRFATM	Median	2.10	6.50	12.30	19.00	<0.001
	Percentile 25	2.10	5.40	10.60	18.70	
	Percentile 75	4.40	9.30	13.80	21.20	
PMM	Median	39.00	44.80	55.60	52.65	<0.001
	Percentile 25	38.00	40.40	48.50	50.20	
	Percentile 75	41.80	54.00	63.50	56.10	
METAAGE	Median	12.00	13.00	34.00	34.00	<0.001
	Percentile 25	12.00	12.00	30.00	33.00	
	Percentile 75	12.00	22.00	34.00	34.00	

*Kruskal-Wallis H.

Table 3 shows the results of multiple linear correlation with the dependent variable (criterion) MRSPTL and predictors: TRFATP, TRFATM, muscle mass in kilograms (PMM), METAAGE. The prediction model explains 44.5% of the variance of the criteria. In this case, higher values for MRSPTL

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are found in subjects with higher response values for PMM (β=0.565, p<0.05) and lower values for TRFATM (β=-0.858, p<0.05), and the model is statistically significant (p<0.05). From the aforementioned Table 3, it can be seen that positive and negative correlations were recorded between the observed variables, the highest significant negative correlations were recorded between the indicators: TRFATP and MFLPRR (r=-0.467; p<0.01) and METAAGE and MFLPRR (r=-0.476; p<0.01), while the highest significant positive correlation was recorded between the indicators: TRFATM and TRFATP (r=0.976; p<0.01), TRFATP and METAAGE (r=0.886; p<0.01).

Table 3. Regression analysis with respect to the dependent variable MRSPTR (group of health students - 73).

	β	*t*	*p*	Model Summary
TRFTATP	**.380**	**.932**	**.355**	**corrected R2 = 0.445 F(4.68) = 15.419 p < 0.001**
TRFATM	**-.858**	**-2.007**	**.049**	
PMM	**.565**	**4.089**	**.000**	
METAAGE	**-.173**	**-.851**	**.398**	

Legend: β = value of standardized regression coefficient; t = t-test value; p = significance level; adjusted R^2 = adjusted total contribution to explained variance; F = value of total F-ratio.

From the above Table 4, it can be seen that there was a positive and negative correlation between the observed variables, the highest significant negative correlations were recorded between the indicators: TRFATP and MFLPRR (r=-0.467; p<0.01) and METAAGE and MFLPRR (r=-0.476; p<0.01), while the highest significant positive correlation was recorded between the indicators: TRFATP and TRFATM (r=0.976; p<0.01), TRFATP and METAAGE (r=0.886; p<0.01). The prediction model explains 34.9% of the variance of the criteria. In this case, a higher value for MRSPTL was found in respondents with a higher response value for PMM (β=0.643, p<0.01) and a lower value for METAAGE (β=-0.911, p<0.05), the model is statistically significant (p<0.05).

Table 4. Spearman correlation coefficient II (group of non-health students – 49).

	1	2	3	4	5	6	7	8	9
1. WEIGHT	**1.000**								
2. TRFATP	**.600****	**1.000**							
3. TRFATM	**.710****	**.976****	**1.000**						
4. PMM	**.877****	**.211**	**.363***	**1.000**					
5. METAAGE	**.641****	**.886****	**.874****	**.323***	**1.000**				
6. MFLPRR	**-.156**	**-.467****	**-.425****	**-.006**	**-.476****	**1.000**			
7. MRSPTL	**.186**	**-.223**	**-.178**	**.409****	**-.298***	**.129**	**1.000**		
8. MRSNK	**.174**	**-.259**	**-.211**	**.407****	**-.232**	**.102**	**.779****	**1.000**	
9. MRPLČ	**.051**	**-.088**	**-.078**	**.132**	**-.173**	**.030**	**.612****	**.511****	**1.000**

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

The prediction model in Table 5 explains 34.9% of the variance of the criteria. In this case, higher values for MRSPTL are found in respondents with higher response values for PMM (β=0.643, p<0.01) and lower values for METAAGE (β=-0.911, p<0.05), and the model is statistically significant (p<0.05).

Table 5. Regression analysis with respect to the dependent variable MRSPTL (group of non-health students – 49).

	β	*t*	*p*	Model Summary
TRFTATP	.482	1.374	.176	corrected R2 = 0.349 F(4.44) = 7.444 p < 0.001
TRFATM	-.073	-.156	.877	
PMM	.643	3.728	**.001**	
METAAGE	-.911	-3.151	**.003**	

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Legend: β = value of standardized regression coefficient; t = t-test value; p = significance level; adjusted R^2 = adjusted total contribution to explained variance; F = value of total F-ratio.

4. Discussion

Our study found notable differences in body composition were observed between students of health-related and non-health-related programs, with the latter group exhibiting generally higher values in fat mass, muscle mass, total body water and segmental body measurements. Although the distribution of BMI categories was similar across both groups, the detailed analysis of body composition reveals distinct physiological profiles that may reflect differences in lifestyle, physical activity levels or even academic demands. These disparities suggest that body composition may be influenced by factors beyond BMI alone, emphasizing the importance of examining fat and muscle distribution when assessing overall health and fitness among student populations.

Negative correlations of estimated values of motor abilities of repetitive strength and flexibility between the values of body fat percentage and metabolic age were also recorded in both groups (Table 1 and Table 4). An optimal body mass index enables easier performance of motor tasks [31–34], and well-developed motor abilities aid in improving health and achieving normal body weight [16,35]. Their interrelation can directly affect the prevention of chronic diseases, functional abilities, social inclusion, development of interpersonal skills, as well as other fundamental aspects related to quality of life [36–39].

The results of our study indicate that the largest proportion of participants from both groups is in the normal body mass category, with 59.0% of them being health students and 41.0% being non-health students. Similar results in the distribution of body mass index in the student population were also recorded in the study by Zaccagni et al. [40], where students from different academic fields also mostly belonged to the normal body mass category. The results of the study by de Faria Filha et al. [41], conducted in 2018 on 2,245 health students in Brazil, indicate the prevalence of overweight (48.3%) and obesity (15.3%) in their study population, while in our study this figure for overweight students is 20%, and for obese students it is 6%. Differences in the distribution of other body mass index categories were also observed. Of the total number of students with malnutrition in both groups (n=7), the percentage recorded in the group of health studies students is 71.4% compared to non-health studies students which is 28.6%. Furthermore, health studies students had a higher percentage of obesity and overweight compared to non-health studies students, however, the difference between the observed groups in the distribution of body mass index is not statistically significant, indicating that the field of study is not necessarily a factor affecting body mass index.

The results also indicate clear differences in the body composition of the participants depending on the body mass index. In both groups, increased values of the observed parameters (fat percentage (%), body fat mass (kg), metabolic age) were recorded in participants with excess body weight, reaching the highest values in the obesity category (Table 2 and Table 5). The percentage of body fat and absolute fat mass progressively increase with increasing body mass index, reaching the highest values in the obesity category, which is in line with the findings of Schutter et al. [42]. These findings indicate an unfavorable effect of an increased body mass index on body composition, with an emphasis on the accumulation of fat tissue [43]. For optimal motor abilities, it is important to maintain a healthy proportion of fat and muscle mass, since this allows for better performance in most physical activities [44]. Muscle mass shows a different pattern, with the highest proportion of muscle mass being recorded in overweight individuals. Reduced muscle mass can also be found in students with malnutrition and/or obesity, suggesting that an increase in body mass index above a certain threshold is not associated with further increases in muscle mass [45]. Also, metabolic age is significantly higher in students in both overweight and obese groups compared to normal weight and malnutrition. The results obtained did not show a statistically significant difference between the groups in bioimpedance scale parameters and performance of motor skills requiring flexibility. However, a negative correlation was observed in the values of the percentage of fat in the trunk and metabolic age in relation to repetitive strength, which includes the ability to lift the trunk from a lying position

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(number of repetitions in 60 seconds) in health students (Table 3). On the other hand, in non-health students, a negative correlation was recorded between the percentage of body fat in the trunk and metabolic age with the ability that requires flexibility, including moving the body in a forward bend with different legs (Table 4). Motor deficits in overweight individuals are most pronounced in motor abilities that require lifting one's own body against gravity [31,46]. The results of the study by Altavilla et al., [47] and Haddad et al. [48] also indicate a clear link between BMI and motor performance. Participants with a normal index showed significantly better motor abilities compared to participants with higher body mass values. The aforementioned studies also confirm that an increased index can negatively affect motor performance due to reduced strength and endurance [47,48], while other studies describe the negative effect associated with increased body fat on motor abilities as a developmental disorder of lack of coordination during movement [31,49–51].

The results of the study indicate that there are statistically significant differences in the motor abilities of students depending on their level of nutrition and BMI. They also highlight the negative impact of an elevated body mass index on body composition and metabolic parameters – and suggest the importance of maintaining optimal body weight in order to reduce the risk of metabolic and functional disorders. An increase in the proportion of body fat can negatively affect muscle strength and endurance, balance and coordination, and can also increase the load on the joints, which can lead to poorer motor performance [52,53]. Also, in addition to reduced and poor motor abilities, it is important to note that negative effects can also extend to influence the perception of personal psychophysical state. A reduced level of the aforementioned abilities can also negatively affect the decision of young individuals to participate in physical and/or sports activities. Understanding the aforementioned relationship between overweight/obesity and motor abilities, along with psychophysical characteristics, can aid researchers develop effective strategies by integrating various psychophysical variables related to the needs of the participants [41,54].

Several limitations of our study should be acknowledged. The relatively small sample size, especially when divided into subgroups based on educational program and BMI categories, limits the generalizability of our findings. Furthermore, the cross-sectional design of the study does not allow for establishing causality between body composition and motor abilities. Then, body composition was assessed using bioelectrical impedance analysis, which (albeit practical and non-invasive) may be influenced by hydration status and other external factors, potentially affecting measurement accuracy. Additionally, factors such as physical activity levels, dietary habits or socio-economic status can have an impact on both body composition and motor performance, but they were not controlled for in this study. Finally, the voluntary nature of participation may introduce a type of selection bias, as students more interested or engaged in health-related behaviors may have been more likely to participate.

5. Conclusions

This pilot study demonstrated statistically significant differences in body composition and motor abilities among students, influenced by their BMI and nutritional status. Students with higher fat tissue levels and elevated BMI showed reduced motor performance, particularly in strength and flexibility tests. These physical limitations may also negatively impact the perception of personal psychophysical well-being, potentially discouraging engagement in physical activities.

Given that the student population represents a critical developmental period for establishing long-term health behaviors, the results emphasize the importance of early identification and intervention. Preventive strategies should be tailored specifically for this group, focusing on promoting regular physical activity, balanced nutrition, but also on awareness of the impacts of body composition on functional health and quality of life. Further research on larger, more diverse samples (and by using longitudinal studies) will be needed to better understand these associations and support the development of effective interventions to improve students' physical fitness and long-term health outcomes.

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