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Original Research Article

PHYSICAL FITNESS STATUS AND ANTHROPOMETRIC CHARACTERISTICS OF MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY IN VIETNAM

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Abstract:

Background: Medical students are expected to model healthy lifestyles, yet evidence suggests a decline in their physical health during training. Early identification of physical fitness levels using anthropometric indicators is critical for timely intervention. This study aimed to assess the physical fitness status of first-year medical students and identify factors associated with fitness classification.

Methods: A cross-sectional descriptive study was conducted from October 2024 to June 2025 among 712 first-year students at Vinh Medical University, Vietnam. Anthropometric data were collected, including height, weight, chest circumference (normal and inhalation), thigh and arm circumference. The Pignet Index was calculated to classify physical fitness into five levels: very strong, strong, medium, weak, and very weak. Independent t-tests and logistic regression analyses were used to examine differences and associations between physical fitness and demographic factors. Statistical significance was set at $p < 0.05$.

Results: The majority of students were female (61.5%), from rural areas (74.4%), and of Kinh ethnicity (86.9%). Males had significantly higher anthropometric values than females in all parameters ($p < 0.01$). The overall mean Pignet Index was 31.02 ± 14.85, with males averaging 25.02 and females 34.77. Physical fitness classification showed 23.3% of students were "very strong," while 24.1% were "weak" or "very weak." A significant association was found between gender and physical fitness status (OR = 0.27, 95% CI: 0.17–0.42, $p < 0.001$), and between ethnicity and fitness (OR = 0.53, 95% CI: 0.29–0.96, $p = 0.03$). No significant association was observed with place of residence.

Conclusions: Substantial gender and ethnic disparities in physical fitness exist among first-year medical students. These findings highlight the need for targeted, gender-sensitive health promotion interventions in medical education. Enhancing physical health in this population is essential not only for individual well-being but also for the development of future health role models.

Keywords: Physical fitness, Pignet index, medical students, anthropometry, gender differences, student health, Vietnam.

INTRODUCTION

Physical health plays a fundamental role in shaping the well-being, academic success, and future professional conduct of medical students. As future healthcare providers, medical students are expected to embody and promote healthy behaviors, serving as role models for patients and communities. Medical schools, therefore, carry the responsibility of ensuring that students are not only academically competent but also physically fit [1]. Physical health education, including training on physical activity and nutrition,

is vital for preventing chronic diseases. Although medical students acknowledge the importance of such training, they frequently report a lack of adequate formal instruction in these areas [2]. Moreover, physical well-being significantly contributes to mental health, helping mitigate stress and improve psychological resilience—an essential factor considering the high-pressure environment of medical training [3, 4].

Despite the known benefits of physical health, numerous studies indicate a worrying trend: the physical condition of medical students tends to deteriorate over the course of their education. The most pronounced decline occurs during the first year, when students are adjusting to the rigors of their academic environment [5]. While some recovery may be observed in later years, baseline health levels are often not fully restored. This deterioration is closely linked to elevated levels of burnout, psychological stress, and a lack of sufficient support structures [6, 7]. Lifestyle factors, including gender, social connections, and engagement in regular physical activity, also influence health-related quality of life. Students with supportive living conditions and consistent exercise habits report better physical and mental outcomes [3, 8].

Anthropometric indicators such as height, weight, waist, hip circumference, and composite indices like the Pignet index are widely used to assess students' physical health and potential risks for conditions such as obesity and metabolic syndrome. These measurements provide a tangible and objective means of evaluating health status and identifying early warning signs. Alarmingly, recent studies have reported a high prevalence of excess weight among medical students, with 18% categorized as overweight and 9% as obese, marking a combined prevalence of 24% [9]. These trends reflect broader global health concerns and highlight the need for systematic health assessments and preventive strategies targeting student populations in medical and health-related fields.

In particular, height and weight measurements are essential in calculating Body Mass Index (BMI), a widely used but sometimes limited indicator of weight status. While useful for broad categorization, BMI does not account for body fat distribution. Therefore, additional anthropometric indices—such as waist circumference, waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR)—are employed to better assess central obesity and related cardiovascular risks [10, 11]. WHtR, for instance, has been found especially effective across diverse populations, including medical students [12, 13]. Less commonly used indices like the Pignet index, can offer more refined assessments of body build and composition, enhancing predictive value for chronic disease risk [14, 15] (Wu et al., 2022; Wu et al., 2021).

Taken together, these findings underscore the urgent need for early health surveillance and intervention among medical students. Anthropometric measures serve not only to identify obesity but also to predict future risk for metabolic syndrome, hypertension, and diabetes [10, 15]. The use of refined indices such as WHtR and Abdominal Volume Index (AVI) provides a more comprehensive understanding of body fat distribution and associated health threats [13, 14]. Recognizing the heightened vulnerability of first-year medical students—who often face abrupt lifestyle changes and increased stress—this study aims to evaluate their current physical fitness status. The findings will serve as a baseline for future interventions designed to enhance health outcomes and promote sustainable, healthy behaviors within the healthcare workforce of tomorrow.

MATERIALS AND METHOD

Study design and participants

This was a cross-sectional descriptive study conducted from October 2024 to June 2025 at Vinh Medical University, Vinh City, Nghe An Province, Vietnam. The study population included first-year undergraduate students enrolled in the 2024–2025 academic year. Inclusion criteria consisted of full-time regular students. Exclusion criteria included individuals with physical deformities affecting body shape (such as kyphosis, scoliosis, or congenital malformations), those with psychiatric conditions, chronic diseases, or a history of surgery within the past six months. In practice, 712 students met the inclusion criteria and were conveniently sampled for participation. The recruitment process involved coordination with class leaders to schedule in-person data collection sessions. Eligible students were interviewed using a structured questionnaire and underwent anthropometric measurements at the research site.

Measurements

Data collected included demographic variables (age, gender, residence, ethnicity) and anthropometric measurements (weight, standing height, chest circumference during normal breathing and maximal inhalation, right thigh circumference, and right flexed arm circumference). The Pignet index was calculated as:

Pignet Index=Standing Height (cm)−[Chest Circumference (cm)+Weight (kg)]

The Pignet index is a classical anthropometric measure used to assess body build and robustness. Based on international classification, a Pignet index of less than 10 indicates a "very strong" physique, 11 to 20 is considered "strong," 21 to 30 is "medium," 31 to 35 is "weak," and above 35 is classified as "very weak." All measurements were performed using standardized instruments, including a Martin anthropometric ruler, a digital weighing scale with a

precision of 0.01 kg, and a measuring tape accurate to 0.1 cm. Trained research personnel conducted all measurements at the study site to ensure consistency and accuracy[16].

Statistical Analysis

Data were cleaned, coded using Microsoft Excel, and analyzed with STATA version 17.0. Descriptive statistics were used to summarize general characteristics. Independent t-tests were applied to assess differences between groups. Logistic regression models with 95% confidence intervals were used to explore associations between independent variables and physical fitness levels.

Ethical Approval

The study protocol was approved by the Ethics Committee of Hanoi Medical University under Decision No. 3657/QD-DHYHN. All participants were informed about the objectives and procedures of the study and provided informed consent. Participation was voluntary, and students were allowed to withdraw at any point without consequences.

RESULTS

Table 1 presents the general characteristics of the 712 first-year medical students included in the study. The majority of participants were female, accounting for 61.5%, while males represented 38.5%. Regarding place of residence, 74.4% of students came from rural areas, whereas 25.6% were from urban settings. In terms of ethnicity, 86.9% identified as Kinh, and 13.1% belonged to other ethnic groups.

Table 1. General characteristics of study participants (n = 712)

Characteristics	Categories	Frequency	Percent (%)
Gender	Male	274	38.5
	Female	438	61.5
Residence	Urban	182	25.6
	Rural	530	74.4
Ethnicity	Kinh	619	86.9
	Other	93	13.1

Table 2 presents that the average weight of all participants was 54.29 ± 10.77 kg, with males averaging 61.92 ± 10.32 kg and females 49.52 ± 7.93 kg. The mean standing height was 161.29 ± 8.37 cm overall, 169.19 ± 5.89 cm for males, and 156.35 ± 5.35 cm for females. Normal chest circumference measured 75.98 ± 8.05 cm overall, with 82.25 ± 6.75 cm in males and 72.06 ± 6.06 cm in females. Chest circumference during maximum inhalation was 79.14 ± 8.28 cm overall, 85.98 ± 6.58 cm for males, and 74.86 ± 6.05 cm for females. The right thigh circumference was 52.43 ± 5.26 cm overall, 53.26 ± 5.42 cm for males, and 51.91 ± 5.08 cm for females. The right upper arm circumference when flexed was 26.10 ± 3.51 cm overall, with males at 28.21 ± 2.98 cm and females at 24.78 ± 3.15 cm. The mean Pignet Index was 31.02 ± 14.85, with a lower value observed in males (25.02 ± 15.86) compared to females (34.77 ± 12.84). All differences between male and female groups were statistically significant with p-values less than 0.01.

Table 2. Anthropometric measurements of study Participants by Gender

Measurement	Overall	Male	Female	p
	$\bar{X}$ ± SD	$\bar{X}$ ± SD	$\bar{X}$ ± SD	
Weight (kg)	54.29 ± 10.77	61.92 ± 10.32	49.52 ± 7.93	< 0.01
Standing height (cm)	161.29 ± 8.37	169.19 ± 5.89	156.35 ± 5.35	< 0.01
Chest circumference (normal) (cm)	75.98 ± 8.05	82.25 ± 6.75	72.06 ± 6.06	< 0.01
Chest circumference (max inhale) (cm)	79.14 ± 8.28	85.98 ± 6.58	74.86 ± 6.05	< 0.01
Right thigh circumference (cm)	52.43 ± 5.26	53.26 ± 5.42	51.91 ± 5.08	< 0.01
Right upper arm circumference (cm)	26.10 ± 3.51	28.21 ± 2.98	24.78 ± 3.15	< 0.01
Pignet Index	31.02 ± 14.85	25.02 ± 15.86	34.77 ± 12.84	< 0.01

**p: t-test comparison between male and female groups.*

Table 3 presents that overall, 23.3% of students were classified as having very strong fitness, 13.3% as strong, 39.3% as medium, 13.8% as weak, and 10.3% as very weak. Among male students, the highest proportion fell into the very strong category (38.7%), while female students were most commonly classified in the medium group (42.5%). The distribution of physical fitness levels differed significantly between males and females ($p < 0.05$).

Table 3. Physical fitness classification based on Pignet Index (n = 712)

Pignet Classification	Overall N (%)	Male N (%)	Female N (%)	p-value
Very strong	166 (23.3)	106 (38.7)	60 (13.7)	<0.01
Strong	95 (13.3)	43 (15.7)	52 (11.9)	
Medium	280 (39.3)	94 (34.3)	186 (42.5)	
Weak	98 (13.8)	21 (7.7)	77 (17.6)	
Very weak	73 (10.3)	10 (3.7)	63 (14.4)	

Table 4 presents the distribution of physical fitness status based on the Pignet Index among 712 participants, categorized by gender, residence, and ethnicity, along with corresponding p-values and odds ratios (OR). Among males, 11.3% were classified as having weak or very weak fitness compared to 32.0% of females, with a statistically significant difference ($p < 0.001$, OR = 0.27; 95% CI: 0.17–0.42). For place of residence, 25.3% of urban students and 23.6% of rural students fell into the lower fitness category, with no significant association ($p = 0.65$, OR = 1.09; 95% CI: 0.74–1.61). Regarding ethnicity, 15.2% of ethnic minority students and 25.4% of Kinh students were in the weak or very weak category, with a significant difference observed ($p = 0.03$, OR = 0.53; 95% CI: 0.29–0.96).

Table 4. Factors associated with physical fitness status based on Pignet Index (n = 712)

Variable	Category	≤ Weak N (%)	> Weak N (%)	p-value	OR (95% CI)
Gender	Male	31 (11.3)	243 (88.7)	< 0.001	1
	Female	140 (32.0)	297 (68.0)		0.27 (0.17–0.42)
Residence	Urban	46 (25.3)	136 (74.7)	0.65	1
	Rural	125 (23.6)	404 (76.4)		1.09 (0.74–1.61)
Ethnicity	Other	14 (15.2)	78 (84.8)	0.03	1
	Kinh	157 (25.4)	462 (74.6)		0.53 (0.29–0.96)

DISCUSSION

The findings of this study provide a comprehensive overview of the physical fitness status and anthropometric characteristics of first-year medical students. The results revealed gender differences in all anthropometric measurements and physical fitness classifications, with males generally having higher physical fitness scores than females. The majority of students had moderate to strong fitness levels, but a notable proportion fell into the weak or very weak category. Factors such as gender and ethnicity were significantly associated with physical fitness status, while place of residence showed no significant relationship.

One of the most prominent findings was the significant difference in physical fitness between male and female students. Male participants had greater mean height (169.2 ± 5.9 cm) and weight (61.9 ± 10.3 kg) than females (156.4 ± 5.4 cm and 49.5 ± 7.9 kg, respectively), with p-values < 0.01. These findings are consistent with previous studies, such as Li et al. (2022), who reported significantly higher height and weight among male Chinese medical students [17]. Similarly, Ángyán et al. (2003) observed that while BMI was within the normal range for both sexes, males tended to have higher BMI due to increased muscle mass [18]. The mean Pignet index further reflected this difference in physical build, with males averaging 25.0 ± 15.9 and females 34.8 ± 12.8 ($p < 0.01$), suggesting a more robust physique in males. This pattern of somatotype disparity is supported by Żarów et al. (2024), who noted that males typically have larger thoracic dimensions and greater upper-body development [19].

The distribution of physical fitness categories also aligned with gender-specific body composition and performance trends. Among male students, 38.7% were classified as "very strong," whereas only 13.7% of females fell into this category. In contrast, 17.6% of females were rated "weak" and 14.4% "very weak," compared to just 7.7% and 3.7% of males, respectively. These findings echo the literature suggesting that males outperform females in strength and endurance-based assessments, while females may score better in flexibility or balance-focused tasks [17]. In this context, higher muscle mass and lower fat percentages in males contribute to greater scores in upper-body strength tasks, such as pull-ups, which influence fitness indices like the Pignet index [20]. Meanwhile, higher fat mass among females, although within normal physiological ranges, may contribute to elevated Pignet scores and a higher prevalence of weaker classifications [17].

Gender was identified as a strong predictor of physical fitness status, with females having significantly lower odds of being in the higher fitness category (OR = 0.27, 95% CI: 0.17–0.42, $p < 0.001$). This association reinforces the role of biological and compositional differences between sexes, as noted in multiple international studies [17, 20]. In contrast, no significant association was observed between place of residence and physical fitness ($p = 0.65$), suggesting that environmental differences prior to university entry did not substantially influence students' physical status. However, a significant difference was found based on ethnicity, with minority ethnic students showing better fitness outcomes (OR = 0.53, 95% CI: 0.29–0.96, $p = 0.03$). This may be attributable to differences in lifestyle or levels of physical labor and activity during adolescence.

These findings have important implications for student health promotion. The significant proportion of students in lower fitness categories underscores the necessity for targeted interventions within the university environment, particularly for female and Kinh students. Universities should consider implementing structured fitness programs, health education workshops, and gender-sensitive strategies

to encourage physical activity. Improving the physical fitness of future healthcare providers is not only beneficial for their personal well-being but also enhances their ability to model healthy behaviors for patients.

This study, however, has several limitations. It was conducted at a single medical university, which may limit the generalizability of the findings to other settings or populations. The cross-sectional design also restricts the ability to infer causality. Additionally, while the Pignet index is a useful tool for assessing somatotype, it does not account for all dimensions of physical fitness such as cardiovascular endurance, flexibility, or body fat percentage. Self-reported data on sociodemographic variables may also be subject to recall bias.

CONCLUSION

In conclusion, the study highlights significant disparities in physical fitness among first-year medical students, especially across gender and ethnicity. The findings call for proactive measures by educational institutions to monitor and enhance students' physical health from the beginning of their training. Promoting a culture of physical well-being within medical schools can contribute to healthier student populations and ultimately, healthier communities.

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