



**ANTHROPOMETRIC INDICATORS OF PHYSICAL DEVELOPMENT  
OF MEDICAL UNIVERSITY STUDENTS UNDER CONDITIONS OF  
ACADEMIC STRESS**

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**Abstract**

Academic stress is recognized as a significant factor influencing the physical health and development of medical university students. The period of higher medical education is associated with prolonged mental workload, irregular nutrition, insufficient physical activity, and sleep deprivation. This study



examines the anthropometric parameters of 1st- and 3rd-year students of the Faculty of General Medicine at Samarkand State Medical University with the aim of identifying changes in physical development indicators under conditions of academic stress. The work contributes to the development of a differentiated approach to health monitoring of medical students.

**Keywords:** Anthropometry, academic stress, medical students, physical development, body mass index, morphometry.

## **Introduction**

### **Relevance of the Study**

Health is the most important value for every person and simultaneously one of the primary indicators of the quality of the educational process. The period of studying at a medical university is distinguished by an extremely high cognitive load, emotional strain, and chronic time deficit. These factors collectively form a specific form of chronic stress — academic stress — which has a multifaceted effect on the functional state and physical development of the body.

According to modern concepts, the health of students is determined not only by their initial physical constitution, but also by the environmental conditions in which they live and study. As N.M. Amosov noted, "health is the natural state of the body, characterized by its balance with the environment and the absence of any painful phenomena." This definition is particularly relevant when analyzing the state of medical university students, who, while studying the fundamentals of health, are often themselves exposed to its deterioration.

A number of domestic and foreign researchers have established that in the process of studying at a university, significant changes occur in the body weight, body mass index (BMI), muscle strength, and body proportions of students. R.I. Aizman emphasizes that all major demographic indicators — including morbidity and disability — depend on the health status of the younger generation. Meanwhile, medical students, due to the specifics of their training, are a particularly vulnerable category of the student population.



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The study of anthropometric parameters of students at different stages of training makes it possible to objectively assess the dynamics of their physical development, identify risk groups, and develop recommendations for the prevention of health disorders associated with academic overload.

### **Purpose of the Study**

To study and compare the anthropometric parameters of physical development of 1st-year and 3rd-year students of the Faculty of General Medicine at Samarkand State Medical University, and to assess the influence of academic stress on physical development indicators, body composition, and functional characteristics of the musculoskeletal system.

### **Material and Methods**

The study included 80 students of the Faculty of General Medicine: 40 first-year students (20 male, 20 female) and 40 third-year students (20 male, 20 female). All subjects were clinically healthy, without endocrine or musculoskeletal pathologies. Measurements were performed in the morning hours, under standardized conditions, in accordance with generally accepted anthropometric methodology.

The following anthropometric indicators were assessed:

- body length (height) — measured using a standard stadiometer;
- body weight — determined using calibrated medical scales;
- chest circumference — at rest (pause), at the height of inspiration, and at full exhalation;
- shoulder circumference — in a relaxed and tensed state;
- waist, hip, and thigh circumferences;
- skinfold thickness — using a Best caliper at standard measurement points;
- hand grip strength — using a dynamometer;
- body mass index (BMI) — calculated by the formula:  $\text{weight (kg)} / \text{height}^2 (\text{m}^2)$ ;
- active body mass index (ABMI) — calculated as:  $\text{active body weight} / \text{body length (m}^3) \times 10$ .



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For mathematical processing of the results, methods of variational statistics were used: arithmetic mean (M), standard error of the mean (m), and Student's t-test for comparing group means. Data were processed using Microsoft Excel.

### **Research Results**

Morphometric methods used in the study are divided into longitudinal (individualizing) and transverse (generalizing). In the longitudinal method, the same individuals are measured repeatedly over a period of time. In the transverse method, a group of individuals of different ages is examined at a single point in time, which allows establishing average growth parameters across age groups.

The standard stadiometer was used for measuring body length: the subject stands with heels, buttocks, and the back of the head touching the vertical stand, with the head positioned so that the lower edge of the orbit and the upper edge of the tragus of the ear are on the same horizontal line.

Chest circumference was measured in three phases — at rest (pause), at maximum inspiration, and at maximum expiration. The tape was passed posteriorly beneath the angles of the scapulae and anteriorly across the lower edge of the areola in males, and at the level of the fourth rib in females.

Grip strength was measured using a hand dynamometer with the arm extended to the side at shoulder level. The measurement was repeated 2-3 times and the highest value was recorded. The relative grip strength index was calculated as:  $\text{grip force (kg)} / \text{body weight (kg)} \times 100$ .

The degree of development of subcutaneous adipose tissue was assessed using a Best caliper at four standard sites: below the inferior angle of the scapula, in the popliteal fossa, above the biceps and triceps muscles, and above the iliac crest. Measurements were performed in triplicate at each site, and the mean value was recorded.

Assessment of body composition (percentage of fat mass and active body mass) was performed using nomograms based on the measured skinfold thickness values.

The study revealed that body length in 1st-year male students ranged from 165.2 to 184.6 cm, with a mean of  $174.3 \pm 1.24$  cm. Body weight ranged from 58.3 to 88.7 kg, averaging  $69.4 \pm 1.52$  kg. In female first-year students, body length



ranged from 155.1 to 172.4 cm (mean  $163.2 \pm 0.97$  cm), and body weight from 48.2 to 67.3 kg (mean  $55.8 \pm 1.10$  kg).

Among 3rd-year male students, body length averaged  $174.8 \pm 1.18$  cm, which was not significantly different from the 1st-year group. However, body weight showed a statistically significant decrease:  $66.1 \pm 1.44$  kg ( $p < 0.05$ ), indicating a tendency toward weight loss under conditions of prolonged academic stress. In female 3rd-year students, the mean body weight was  $53.2 \pm 0.98$  kg, which was also lower than in 1st-year students ( $p < 0.05$ ).

**Table 1. Comparative anthropometric parameters of 1st and 3rd year medical students**

Parameter	1st year Males (n=20)	3rd year Males (n=20)	1st year Females (n=20)	3rd year Females (n=20)
Height (cm)	$174.3 \pm 1.24$	$174.8 \pm 1.18$	$163.2 \pm 0.97$	$163.5 \pm 1.02$
Weight (kg)	$69.4 \pm 1.52$	$66.1 \pm 1.44^*$	$55.8 \pm 1.10$	$53.2 \pm 0.98^*$
BMI (kg/m <sup>2</sup> )	$22.8 \pm 0.41$	$21.6 \pm 0.38^*$	$20.9 \pm 0.36$	$19.9 \pm 0.33^*$
Chest circ. at pause (cm)	$89.2 \pm 0.84$	$88.4 \pm 0.91$	$79.6 \pm 0.72$	$78.8 \pm 0.68$
Grip strength (kg)	$38.2 \pm 1.10$	$35.4 \pm 1.02^*$	$23.1 \pm 0.84$	$21.6 \pm 0.79^*$

Note: \* — statistically significant difference compared to 1st year students ( $p < 0.05$ )

### **Discussion of Results**

The results of the study demonstrated that the transition from the 1st to the 3rd year of study at a medical university is accompanied by statistically significant decreases in body weight, BMI, and hand grip strength in both male and female students. These changes were observed against a background of practically unchanged body length, which confirms their functional and stress-related, rather than constitutional, nature.

A decrease in body weight by an average of 3.3 kg in males and 2.6 kg in females over two years of study most likely reflects a combination of factors: irregular eating habits, chronic psycho-emotional stress, insufficient physical activity, and



disruption of the sleep-wake cycle. These findings are consistent with data from foreign studies showing that medical students have an increased risk of nutritional deficit and muscle mass loss compared to students in other specialties.

The reduction in grip strength — by 7.3% in males and 6.5% in females — indicates a decrease in muscle performance, which may be a consequence of both reduced physical activity and catabolic processes associated with chronic stress. The relative grip strength index also decreased, confirming that the reduction in muscle force is not merely proportional to weight loss.

Chest circumference parameters did not show statistically significant differences between year groups, which may indicate preserved respiratory function of the thorax despite general physical deconditioning. However, there was a tendency toward a decrease in chest excursion (the difference between circumference at inspiration and expiration), which requires further investigation.

The data obtained are consistent with the concept formulated by V.P. Petlenko, who defined health as "a normal psychosomatic state of a person capable of realizing his potential of bodily and spiritual forces." The observed negative dynamics of physical development indicators in medical students suggests that the conditions of medical education do not always meet the requirements for the preservation of this potential.

## **Conclusions**

1. Third-year medical students demonstrate statistically significant reductions in body weight (by 4.8% in males and 4.7% in females) and BMI compared to first-year students, while body length remains unchanged.
2. Hand grip strength decreases significantly between the 1st and 3rd years of study, indicating a reduction in muscular performance under conditions of prolonged academic stress.
3. Chest circumference parameters show a tendency toward decrease in chest excursion, which may reflect early functional changes in the respiratory system.
4. The results confirm the need for systematic anthropometric monitoring of medical students throughout their training, with particular attention to body weight, BMI, and muscle strength as sensitive indicators of the impact of academic stress.



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5. It is recommended to introduce preventive measures aimed at optimizing the physical activity regime, normalizing nutrition, and psycho-emotional health of medical university students.

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