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**Kateryna Hennadiivna Koval**
Bohdan Khmelnytskyi National University of Cherkasy
kolybri.777@gmail.com
ORCID ID: https://orcid.org/0009-0003-2920-2343
**Serhii Mykolaiovych Khomenko**
Bohdan Khmelnytskyi National University of Cherkasy
skhomenko@ukr.net
ORCID ID: https://orcid.org/0000-0003-0918-8735
**Liliia Ivanivna Yukhymenko**
Bohdan Khmelnytskyi National University of Cherkasy
liyukhimenko@ukr.net
ORCID ID: https://orcid.org/0000-0002-4455-6233

# THE ROLE OF PHYSICAL ACTIVITY AND NUTRITION IN THE FORMATION OF STUDENTS' PSYCHOPHYSIOLOGICAL ADAPTATION TO THE EDUCATIONAL PROCESS UNDER CONDITIONS OF MARTIAL LAW

***Relevance.*** *Psychophysiological adaptation (PA) is essential for successful academic achievement and functioning during chronic stress. This issue is particularly relevant in Ukraine, where students face martial law conditions, sleep deprivation, poor nutrition, and elevated academic demands. Understanding how body mass index (BMI), physical activity, and dietary behaviour modulate adaptation is crucial for developing targeted interventions.*

***Aim.*** *To determine the relationships between PA and behavioural factors (BMI, physical activity, dietary patterns) among university students, and to develop practical recommendations for optimising psychophysiological status during chronic stress.*

***Materials and Methods.*** *The study involved 76 male university students (38 students of sports specialities, 38 students of non-sports specialities, aged 17–28 years). PA was assessed using the computerised programme "Integral Assessment of Human Psychophysiological Adaptation" (CP IAHPA). Physical activity was evaluated using IPAQ, and dietary behaviour using FFQ. Statistical analysis was performed using Microsoft Excel 2016.*

***Results.*** *Students of sports specialities demonstrated significantly higher PA (59.4 ± 2.1 points) versus students of non-sports specialities (42.8 ± 1.9 points; $p < 0.05$). A statistically significant negative correlation of moderate strength was found between BMI and PA ($r = -0.51$, $p < 0.01$). Students with normal BMI showed higher adaptation levels (32.1% with high PA) compared to those with excess weight (12.5%; $p < 0.05$). Three risk profiles were identified: low risk (85.5%), moderate risk (8.0%), and high risk (13.2%), the latter requiring targeted intervention.*

***Conclusions.*** *Regular physical activity exerts a pronounced protective effect against the development of maladaptive states. The identified negative association between BMI and PA suggests that weight management through combined physical activity and dietary normalisation offers significant potential for psychophysiological improvement. Multidisciplinary interventions including stress management training, physical activity programmes, nutritional counselling, and psychological support are essential, particularly during wartime conditions.*

***Key words:*** *psychophysiological adaptation, body mass index, physical activity, dietary behavior, chronic stress, stress resistance, martial law.*

**Introduction.** Psychophysiological adaptation (PA) is a complex biopsychological process encompassing the integrated interaction of neuroendocrine, autonomic, and somatic mechanisms aimed at ensuring homeostasis and effective functional activity of the organism under conditions of a changing environment [1, 2]. In the context of students' educational activity, PA represents a

dynamic process of adaptation to a complex of stressogenic factors within the academic environment, including cognitive load, emotional tension, and social demands [1, 2, 3].

However, the contemporary reality of Ukrainian students has qualitatively transformed the paradigm of understanding PA. Since 2022, following the onset of full-scale Russian aggression, Ukrainian students have been in a state of persistent chronic stress caused by martial law: constant threat, frequent air-raid alarms, sounds of explosions, uncertainty about the future, and fear for their own lives and the lives of their relatives [1, 2]. Such a state of chronic psychological tension is combined with traditional stressors of the educational process: examinations, assessments, written reports, an intensive pace of study, and high mental workloads [1, 2, 3].

Thus, there is effectively a superposition of two levels of stress – existential (war-related) and academic – creating a specific, intense stress situation that negatively affects various systems of the students' organism. This leads to the risk of critical depletion of adaptive reserves, sleep disturbances, the development of maladaptive eating patterns, and a significant decrease in motivation for physical activity, which destabilises stress resistance in young people [1, 2].

It is known from the literature that regular physical activity modulates adaptive mechanisms through optimisation of functions within the hypothalamic-pituitary-adrenal (HPA) axis and metabolic neurotrophic support [4, 5]. Physical activity acts as a powerful factor counteracting the development of mental disorders and contributes to strengthening stress resistance mechanisms in students [6]. On the other hand, morphological body factors (body mass, height, circumferences) and nutritional characteristics (rationality, balance, regimen) are of great importance, as they directly influence neuroendocrine and emotional regulation of physiological processes [7, 8]. It has been established that overweight signals low-grade chronic inflammation and adipokine imbalance, which disrupts the functioning of the prefrontal cortex and activates the amygdala – the centre of fear and anxiety [8, 9, 10]. The authors emphasise that in students already experiencing stress due to martial law, overweight further worsens the organism's ability to cope with it [5, 8, 11].

It has been found that diet quality can modulate the composition of the gut microbiome, which is involved in regulating the synthesis of neurotransmitters necessary for emotional stability, cognitive activity, etc. Gazolla J. C., Yoon E. S. and their co-authors emphasise that a diet rich in ultra-processed foods is associated with emotional instability and may contribute to deterioration of mental health [12, 13]. This situation may pose significant risks to the health of young people studying under martial law conditions.

According to scientific studies by Kisiel D. et al., the psychophysiological mechanisms of student adaptation under chronic stress depend on various behavioural factors, including the level of physical activity and dietary behaviour [1]. According to studies by Tilov B., Shevchenko S., Kokun O. M. et al., a high prevalence of depressive symptoms and anxiety disorders is observed among students, especially during periods of intensive study [8, 9, 11].

Modern psychophysiology recognises that the adaptive capacity of the organism depends on a complex of behavioural, individual characteristics and environmental factors [2, 8]. Body mass index (BMI), level of physical activity, and quality of dietary behaviour are considered modifiable factors that significantly affect the psychophysiological status of a person and their stress resistance [7, 10, 11, 14]. The results of studies by Salmon P., Hamer M., Brownley K. demonstrate that increased BMI correlates with elevated psychological stress and reduced emotional resilience in young people [4, 5, 6]. Regular physical activity acts as a powerful means of protecting students' health from stressogenic influences and contributes to the development of their stress resistance [1]. Conversely, a deficiency of physical activity creates conditions for chronic inflammation and the development of imbalance in the autonomic nervous system, significantly reducing the adaptive reserves of the organism [12, 13].

Thus, the relevance of studying the relationship between adaptive capacity, morpho-functional characteristics of the organism, and dietary behaviour is caused by the lack of comprehensive data and the need to clarify their role in the formation of PA in Ukrainian students under martial law conditions. Most previous studies have examined these factors in isolation,

without considering their synergistic influence [1, 2, 3]. Moreover, to date, there are no differentiated programmes of psychohygiene and health preservation developed with regard to the specific military-political situation in the country and its psychological, physiological, and social consequences for the student youth.

**Statement of the problem and purpose of the study.** The current military situation in Ukraine has created extreme conditions for the PA of students in relation to learning. Unlike students studying in peaceful countries who face only traditional academic stress, Ukrainian students experience its layering with stressogenic factors of martial law, namely:

- constant threat to life and safety manifested by frequent air-raid alarms, explosions, concern for relatives and friends, uncertainty about the future, loss of stability, and psychological trauma (loss of life, damage to infrastructure);
- an intensive pace of study in various formats (full-time, part-time, distance, blended), characterised by high mental loads caused by interruptions or absence of heating and electricity; difficulties related to access to information and assimilation of educational material. All this occurs under conditions of competition with peers, uncertainty regarding future employment, and safety of life in a country at war.

Such layering of influencing factors produces a synergistic effect, where both stress levels reinforce each other, creating challenges that far exceed the natural adaptive capacities of the organism, especially after several years of continuous war under conditions of depleted reserves [11, 15].

It has been established that during periods of high psychological tension, students exhibit a significant increase in depression and anxiety levels [8, 16]. Despite this, the majority of modern studies consider stress in isolation (either academic or psychosocial), without taking into account their cumulative combined effect on the psychophysiological status of young individuals. To date, studies of the interrelationships between physical development characteristics, level of physical activity, and diet quality – which simultaneously affect adaptive capacity, particularly psychophysiological adaptation to learning under conditions of dual stress (martial law and academic load) – are almost absent. It remains unknown which behavioural factors most effectively protect students from states bordering on maladaptation in such extreme conditions. Furthermore, the current scientific literature contains virtually no differential (or personalised) health-promoting programmes designed to support the physical and mental aspects of health and to mitigate the psychophysiological effects of stressful situations on Ukrainian students living and studying under the specific conditions of martial law.

**The purpose of our research** was to determine the role of physical activity and nutrition in the formation of psychophysiological adaptation of students to the educational process under martial law conditions.

Research objectives:

- to describe and assess morphological (by BMI), functional (by level of physical activity) characteristics of the organism and the lifestyle and quality of nutrition of students;
- to perform correlation analysis between indicators of PA, BMI, characteristics of dietary behaviour, and level of physical activity of students;
- to create and substantiate an empirical risk profile of PA;
- to develop practical recommendations for optimisation of the educational process and support of students' PA.

**Organisation and methods of the study.** The study involved 76 practically healthy male volunteers – students of higher education at Bohdan Khmelnytskyi National University of Cherkasy (aged 17–28 years), who were divided into two experimental groups: students of sports specialities (n = 38) and students of non-sports specialities (n = 38). The group of sports specialities consisted of students of the Educational and Scientific Institute of Physical Culture, Sport and Health, who regularly engaged in physical activity (≥10 hours per week of organised physical activity). The group of non-sports specialities included students of faculties of psychology, computer engineering, intelligent and control systems, as well as the Educational and Scientific Institute of Pedagogical

Education, Social Work and Arts, who did not engage in systematic professional physical training. Data collection was carried out during 2024-2025 in the intersession period.

To determine the level of PA, psychophysiological testing was conducted using the author's computerised programme "Integral Assessment of Human Psychophysiological Adaptation" (CP IAHPA) [15]. The PA index was determined within the range of 30.0–70.0 points and above. It was assumed that PA ≥ 56.0 points indicated high adaptation, 49.0–55.99 points – average adaptation, 40.0–48.99 points – low adaptation, ≤ 39.99 points – critically low adaptive reserves.

Anthropometric measurements included height measurement using a Martin stadiometer (cm) and body mass determination (kg) using medical floor scales (accuracy 0.1 cm and 0.1 kg respectively). BMI was calculated according to formula 1.

$$BMI = m / h^2 \quad (1)$$

where BMI – body mass index;
m – body mass in kg;
$h^2$ – square of height in metres.

BMI (kg/m²) was categorised according to WHO recommendations: underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), obesity (≥30) [8]. Functional muscle strength was assessed using hand dynamometry by determining maximum grip strength of the right and left hands (kg) and back muscle strength (kg).

The nature and intensity of physical activity were assessed using the International Physical Activity Questionnaire (IPAQ), validated for adults [16]. IPAQ differentiates results into low (<600 MET-min/week), moderate (600–2999 MET-min/week), and high (≥3000 MET-min/week) physical activity.

Dietary behaviour was assessed using the Food Frequency Questionnaire (FFQ), adapted for the Ukrainian context, including consumption of fruits, vegetables, whole grains, proteins, as well as stimulants, processed foods, and sugar-containing products [14].

Statistical analysis was performed using Microsoft Excel 2016 and standard methods of mathematical statistics. Descriptive statistics included mean (M), standard error (SE), standard deviation (SD), and range. Data normality was confirmed by the Shapiro–Wilk test. Differences between independent groups were assessed using Student's t-test, while qualitative variables were analysed with the $\chi^2$ test. Correlations were determined using Pearson's coefficient (r) with significance level (p); correlation strength was classified as weak ($|r| = 0.1–0.3$), moderate ($|r| = 0.3–0.5$), and strong ($|r| > 0.5$). Statistical significance was set at $p < 0.05$. Data are presented as M ± SE (mean value ± standard error). All student assessments in this study were conducted in accordance with the principles of the Declaration of Helsinki (1975, revised 1996–2013). At the time of examination, participants were practically healthy and provided written informed consent to participate. The obtained data were used solely for scientific purposes under conditions of full anonymity and confidentiality.

**The results of the study and their discussion.** The distribution of higher education students in both groups by levels of PA that we conducted revealed the existence of significant differences (Fig. 1). The figure shows that in the group of examined students of sports specialities, 10 of them (which accounted for 26% of the total number of participants in this group) had a high level of PA, 25 individuals (66%) had a medium level, and 3 students (8%) had a low level. At the same time, none of the students in this group demonstrated a critically low level of PA.

In contrast, in the group of students of non-sports specialities, only 2 individuals (5%) had a high level of PA, 15 students (40%) showed a medium level, 16 individuals (42%) had a low level, and 5 participants (13%) were characterised by a critically low level ($p < 0.05$). It is possible that the differences we identified in the distribution of PA levels in favour of better indicators among athletes can be explained by the positive effect of regular physical activity on their adaptive mechanisms. Similar results were obtained by Kisiel D., Gazolla J. C., Brownley K. A. [1, 12, 6].

In addition, Tilov B., Holubnycha L., and Dakanalis A. emphasised that psychosocial determinants, including activity level, significantly affect adaptive capacity [8, 17, 10].

Furthermore, it was found that students from the group of sports specialities were characterised by a significantly higher level of PA (59.4 ± 2.1 points) compared with students from the group of non-sports specialities, respectively 42.8 ± 1.9 points ($p < 0.05$).

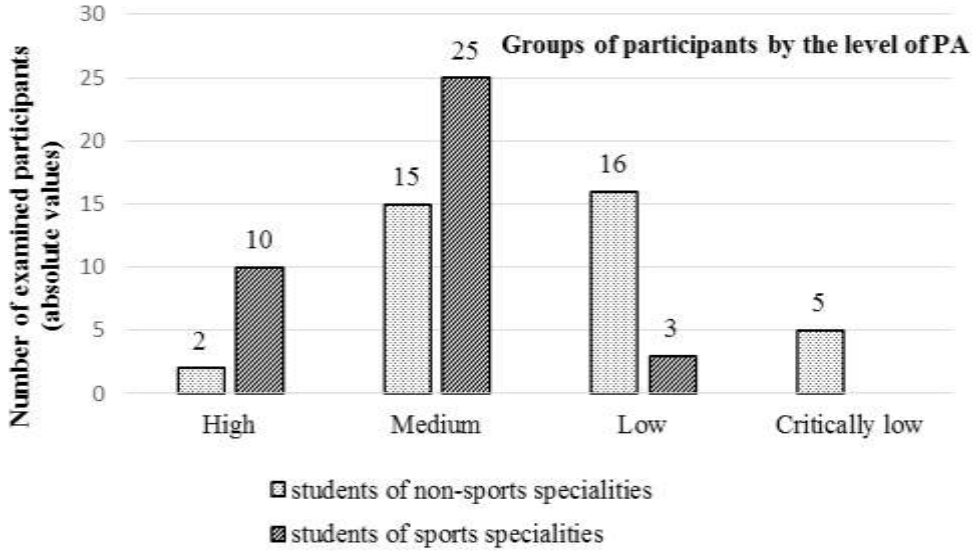


Fig. 1. Quantitative distribution of the examined participants by levels of psychophysiological adaptation (PA); * – significance of differences $p < 0.05$.

This additionally indicated a substantial positive effect of regular physical activity on the adaptive capacity of the organism. Our results are consistent with the data of other authors, such as Gazolla J. C., Salmon P., Hamer M., Yoon E. S., Sabu S. and their co-authors, who emphasised that physical activity with elements of self-determined motivation significantly improves psychophysiological status and emotional stress resistance in young people [4, 5, 7, 12, 13].

Thus, it can be assumed that the differences in PA established by us between the examined groups may indicate optimisation of regulatory mechanisms of the HPA axis and a higher overall tone in students who regularly engage in physical culture. This enables them to cope more effectively with chronic stress [4, 12].

It is known from the literature that systematic aerobic training reduces the reactivity of the HPA axis to stress stimuli and enhances parasympathetic regulation of cardiac activity, which manifests as lower anxiety and better emotional stability. According to Gazolla J. C. et al., such mechanisms are ensured through optimisation of neuroendocrine processes and autonomic regulation [12]. According to Sabu S., systematic physical activity promotes the synthesis of neurotrophic factors and improves cognitive function under conditions of chronic stress [7].

It should be noted that a large proportion of the examined students from the sports group had high and medium levels of PA (which amounted to 92.1% of their total number). This confirms that systematic physical training ensures stable functioning of adaptive mechanisms [3, 9, 11].

At the same time, 7.9% of participants in this group demonstrated a low level of PA. Further analysis established that this level in these participants was due to their being in a state of convalescence after a short-term illness or minor injury, or due to personal circumstances that could temporarily reduce the regularity of their training. This once again emphasises that even in a physically active population, short-term interruptions in training can result in a noticeable decline in functional state and the development of maladaptive processes.

At the same time, the examined individuals of non-sports specialities were characterised by a high proportion of maladapted students: 42.1% had a low level, and 13.2% had a critically low level of PA. Such a distribution indicates insufficient adaptive mechanisms to stressogenic factors

among physically untrained students [1, 2, 3]. Our results are consistent with the data of Yoon E. S., who emphasised that young people with low physical activity exhibit significantly higher levels of anxiety and depression, which negatively affects their ability to cope with stress [13]. Thus, a deficit of physical activity in combination with other negative maladaptive behavioural factors leads to a pronounced inability to adapt among student youth [4–6, 18].

We analysed BMI and muscle strength indicators in students with different levels of PA (Table 1). It was found that among students of non-sports specialities there was a clear gradient of dependence of PA level on BMI. Specifically, as BMI increased, muscle strength indicators consistently decreased, which has also been emphasised by other authors [8, 10, 14]. Representatives of the sports group demonstrated a qualitatively different profile: even students with a "low" level of PA by group standards had significantly higher muscle strength and lower BMI (24.17 ± 1.15 kg/m²) than the best-adapted individuals from the non-sports group. This convincingly demonstrates that systematic motor activity and physical loads provide a fundamentally higher baseline of both adaptive potential and muscle strength [1, 4]. Yoon E. S., Salmon P., Hamer M. showed that sufficient muscle strength correlates with neurotrophic factors, HPA axis functions, and psychological resilience under chronic stress [4, 5, 13].

**Table 1.**

Indicators of BMI and muscle strength in students with different levels of psychophysiological adaptation

| Indicators | High PA level | Medium PA level | Low PA level | Critically low PA level |
|---|---|---|---|---|
| Students of non-sports specialities (n = 38) | | | | |
| Number of examined participants | 2 | 15 | 16 | 5 |
| BMI, kg/m² (M ± SE) | 21.45 ± 1.52 | 23.61 ± 0.40 | 25.45 ± 0.56 | 28.34 ± 1.19 |
| Dynamometry: right hand, kg | 31.50 ± 2.50 | 25.49 ± 0.99 | 21.83 ± 1.50 | 18.27 ± 2.05 |
| Dynamometry: left hand, kg | 28.50 ± 2.30 | 22.11 ± 0.96 | 17.92 ± 1.23 | 15.65 ± 1.88 |
| Dynamometry: back, kg | 81.00 ± 7.50 | 62.38 ± 3.35 | 52.47 ± 5.54 | 44.21 ± 6.84 |
| Students of sports specialities (n = 38) | | | | |
| Number of examined participants | 10 | 25 | 3 | – |
| BMI, kg/m² (M ± SE) | 20.52 ± 0.48 | 21.84 ± 0.65 | 24.17 ± 1.15 | – |
| Dynamometry: right hand, kg | 38.94 ± 1.72 | 36.18 ± 1.95 | 28.67 ± 2.80 | – |
| Dynamometry: left hand, kg | 36.22 ± 1.84 | 33.47 ± 1.99 | 26.00 ± 2.65 | – |
| Dynamometry: back, kg | 110.28 ± 4.95 | 102.06 ± 5.45 | 78.33 ± 8.12 | – |

Note: M ± SE – mean value ± standard error; BMI – body mass index; PA – psychophysiological adaptation.

We found that in 3 students of sports specialities with a low level of psychophysiological adaptation, BMI ranged within 24.17 ± 1.15 kg/m² (slight overweight), but according to dynamometric indicators (28.67 kg for the right hand, 78.33 kg for back strength), they significantly exceeded even the best-adapted non-athletes (with dynamometric results of 31.50 kg for the right hand and 81.00 kg for back strength). This fact demonstrates that even in athletes with temporarily reduced PA, the baseline of physical fitness remains significantly higher than in non-sporting youth.

We analysed BMI in both examined groups, which allowed us to identify clear intergroup differences. Thus, students of sports specialities were predominantly characterised by normal body weight. 33 individuals (which accounted for 87% of the group) had normal BMI (18.5–24.9 kg/m²), while 5 students (13%) were overweight (25.0–29.9 kg/m²). At the same time, no cases of obesity or underweight were detected in this group. In contrast, in the group of non-sports specialities, the BMI distribution was less favourable: 23 individuals (61%) had normal body weight (18.5–24.9 kg/m²), 11 students (29%) were overweight (25.0–29.9 kg/m²), 3 individuals (7%) had obesity (≥30 kg/m²), and 1 student (3%) had underweight (<18.5 kg/m²).

We were interested in how PA levels (from high to critically low) were distributed in the groups of sports and non-sports specialities with normal BMI, and what the distribution of PA levels was among students who were overweight. The results of this distribution are presented in Fig. 2.

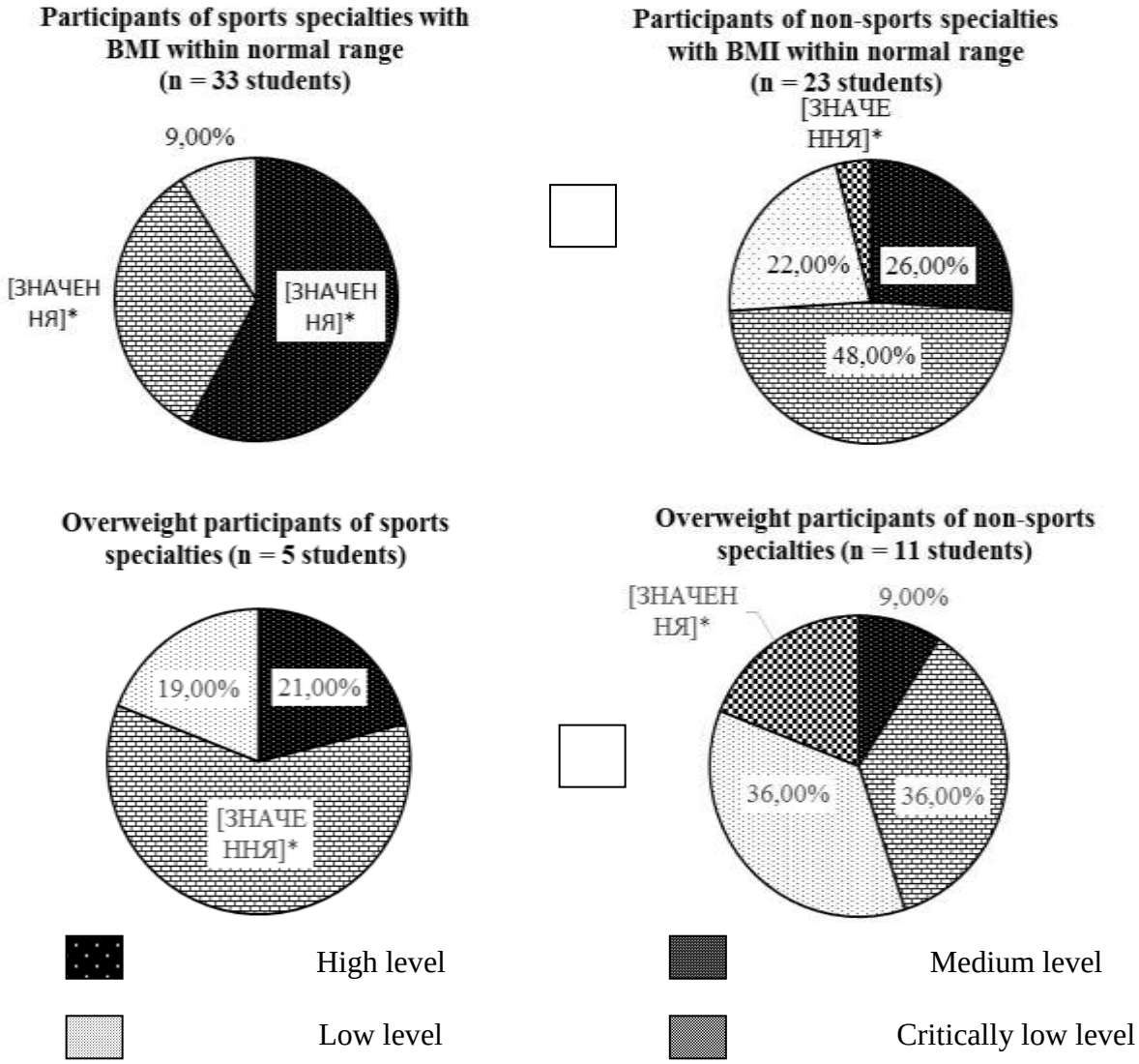


Fig. 2. Distribution of students (%) by PA levels in groups of sports and non-sports specialities with normal BMI (A) and BMI indicating overweight (B); * – statistical significance of differences ($p < 0.05$) within the group compared with overweight participants

Among students of sports specialities with normal BMI (n = 33), a predominance of a high level of PA (58%) was established, with no critically low values and a small proportion of individuals with a low level of adaptive capacity (9%). Overall, such a distribution may indicate a sufficient level of functional reserves of the organism in athletes, effective regulation of autonomic functions, optimal cardiovascular system activity, and high neurodynamic balance. It is likely that regular muscular activity in this group acts as a leading factor in the formation of sufficient adaptation, ensuring economisation of physiological processes and increased tolerance to mental loads.

Among students of the same group but who were overweight (n = 5), the proportion of individuals with a high level of PA was only 21%, which was significantly lower compared to athletes without excess weight ($p < 0.05$). The dominant level among overweight individuals was medium PA (60.0%), whereas in athletes with normal BMI this level occurred almost twice as rarely ($p < 0.05$). The proportion of individuals with low PA did not exceed 19%. This distribution is likely due to the fact that overweight created additional load on the cardiorespiratory system, limiting the efficiency of energy supply for academic activity. At the same time, regular physical activity partially compensated for the negative impact of increased BMI, preventing the transition to critically low PA values.

Attention is drawn to the distribution of PA levels in the group of students of non-sports specialties with normal BMI (n = 23). In this group, a shift of distribution towards medium (48%) and low (22%) PA levels was observed, and the presence of critically low PA was detected in 4% of participants. This indicates insufficient mobilisation of adaptive mechanisms in the absence of systematic physical activity. Despite relatively normal morphometric indicators, functional reserves of the organism in this group were limited, confirming the leading role of physical activity in maintaining adaptive potential.

The most pronounced decrease in adaptive capacity was recorded in untrained students who were overweight (n = 11), where only 9% had a high level of PA, while the proportion of individuals with low and critically low levels totalled 54.5%. Particularly concerning is the nearly fivefold increase in the prevalence of critically low PA compared with those with normal BMI ($p < 0.05$). This distribution likely indicates depletion of adaptive reserves, possible imbalance of autonomic regulation towards sympathicotonia, low efficiency of neurohumoral regulation, and impaired stress reactivity.

Thus, our findings convincingly demonstrate that normal body weight is associated with a high adaptive potential, whereas being overweight has a negative impact on the body's ability to cope with chronic stress [8, 9, 14]. According to the findings of Tilov B. et al., the mechanisms underlying this association include dysregulation of the HPA axis and increased systemic inflammation, which, in the context of overweight, place additional stress on the body [8]. Studies by Gazolla, J. C. et al. have shown that obesity and overweight are accompanied by a decline in cognitive function and emotional stability, which makes it more difficult to cope with academic stress [12].

To confirm the established links between PA and BMI, we conducted a correlation analysis. This revealed a statistically significant negative correlation in the average density between BMI and PA ($r = -0.51$, $p < 0.01$), (Table 2). This relationship demonstrates that the higher the BMI value, the lower the body's ability to adapt to stress, which is consistent with the findings of other researchers [7, 9, 10]. We are inclined to believe that the mechanisms underlying this negative correlation may be multifactorial. After all, overweight, especially when caused by the accumulation of adipose tissue, triggers the activation and unfolding of pro-inflammatory biochemical cascades and creates an imbalance of adipokines, which disrupts hippocampal function [8]. It is also known that visceral obesity is associated with dysregulation of the HPA axis and a persistent elevation of basal cortisol levels [9]. The literature contains evidence suggesting that obesity causes an imbalance in the regulatory function of the autonomic nervous system, which significantly reduces the body's ability to rapidly restore homeostasis [10]. The weak negative correlations between BMI and dynamometric parameters that we have established are consistent with the findings of other authors [8, 10, 12]. Thus, according to Dakanalis A. and co-authors,

sarcopenic obesity is a condition characterised by the accumulation of adipose tissue alongside a loss of muscle mass, which significantly impairs functional capacity and PA [10].

At the same time, we identified positive correlations between PA and dynamometric parameters, which were of moderate strength. These correlations confirm the existence of a fundamental relationship between adaptive capacity and functional muscle strength [12]. According to the findings of Yoon E. S. and co-authors, strength training positively modulates psychophysiological markers of stress and improves emotional regulation [13]. Thus, the better the muscle strength indicators, the higher the level of PA. This confirms the fact that physical condition and PA are inseparably linked aspects of a person's overall health [16, 17].

To determine the nature of nutrition (FFQ) and the level of physical activity (IPAQ) among the groups of students we examined, we analysed the results of the questionnaire survey and identified significant differences in behavioural factors between them [14, 16]. Thus, in the group of students of non-sports specialties, only 19% consumed an adequate amount of fruit and vegetables (≥5 portions per day), 61% demonstrated an insufficient level of physical activity (<150 minutes of aerobic activity per week), and 20% frequently skipped meals during periods of increased stress ($p<0.05$).

**Table 2.**

Results of the correlation analysis between BMI, PA,
and muscular strength indicators in the examined groups of higher education students

| Indicator 1 | Indicator 2 | r | p | n | Type of correlation |
|---|---|---|---|---|---|
| Students of non-sports specialities | | | | | |
| BMI, kg/m² | PA, points | −0.51 | <0.01 | 38 | Moderate negative |
| BMI, kg/m² | Dyn.: right hand, kg | −0.34 | <0.05 | 38 | Weak negative |
| BMI, kg/m² | Dyn.: left hand, kg | −0.32 | <0.05 | 38 | Weak negative |
| BMI, kg/m² | Dyn.: back, kg | −0.36 | <0.05 | 38 | Weak negative |
| PA, points | Dyn.: right hand, kg | 0.33 | <0.01 | 38 | Moderate positive |
| PA, points | Dyn.: left hand, kg | 0.32 | <0.01 | 38 | Moderate positive |
| PA, points | Dyn.: back, kg | 0.34 | <0.01 | 38 | Moderate positive |
| Students of sports specialities | | | | | |
| BMI, kg/m² | PA, points | −0.38 | <0.01 | 38 | Moderate negative |
| BMI, kg/m²² | Dyn.: right hand, kg | −0.24 | <0.05 | 38 | Weak negative |
| BMI, kg/m²² | Dyn.: left hand, kg | −0.22 | <0.05 | 38 | Weak negative |
| BMI, kg/m² | Dyn.: back, kg | −0.26 | <0.05 | 38 | Weak negative |
| PA, points | Dyn.: right hand, kg | 0.43 | <0.01 | 38 | Moderate positive |
| PA, points | Dyn.: left hand, kg | 0.41 | <0.01 | 38 | Moderate positive |
| PA, points | Dyn.: back, kg | 0.45 | <0.01 | 38 | Moderate positive |

Note: r – Pearson correlation coefficient (0.1–0.3 – weak, 0.3–0.5 – moderate, >0.5 – strong correlation); p – level of statistical significance; n – number of participants; BMI – body mass index; PA – psychophysiological adaptation; dyn. – dynamometry.

At the same time, students of sports specialities who engaged in physical activity ≥3 times per week preferred foods with a low glycaemic index, demonstrated higher PA levels, and reported fewer psychosomatic complaints.

Numerous studies have described the mechanisms underlying the positive effects of physical activity on PA [4–6, 9, 10, 13]. According to Kisiel D., as well as Sabu S. and their co-authors, physical activity reduces systemic inflammation and improves cognitive function in individuals experiencing chronic stress [1, 7]. It is known that regular physical activity promotes the synthesis of brain-derived neurotrophic factor and enhances neuroplasticity [1, 3]. According to Gazolla J. C. et al., adequate motivation for physical activity is a key factor in students' psychophysiological health [12]. Regarding dietary behaviour, we are inclined to believe that a diet rich in polysaccharides and antioxidants contributes to the integrity of the blood-brain barrier and supports a healthy gut microbiome composition [12, 14]. The literature emphasises that adherence to a balanced diet is associated with a higher level of psychophysiological well-being among students [8, 10]. Conversely, according to Shevchenko S., stressful conditions often lead to dysregulation of dietary behaviour and the selection of unhealthy foods, which significantly worsens adaptation [9].

Subsequently, we classified participants from both groups according to their PA levels and identified three groups: low, medium, and high risk of developing maladaptive reactions.:

1. *Low-risk group,* comprising individuals with high and medium PA levels (n = 65; 85%). Representatives of this group demonstrated PA within the range of 49–70 points, indicating relatively well-functioning adaptive mechanisms [15]. This group included 35 students of sports specialities (92% of the sports group), who were physically active and adhered to a rational diet, and 30 students of non-sports specialities (79% of the non-sports group).

2. *Medium-risk group,* mainly consisting of individuals with low PA levels (n = 6; 8%). Their PA ranged between 40–48 points, indicating a moderate reduction in adaptive capacity [15]. This group included 3 students of sports specialities (8%) and 3 students of non-sports specialities (8%). These students required targeted interventions aimed at increasing physical activity and normalising dietary behaviour.

3. *High-risk group,* consisting of students with critically low PA levels (n = 10; 13%). These individuals had PA values <40 points, indicating severe maladaptation and critical depletion of adaptive reserves [15]. This group consisted exclusively of 10 students of non-sports specialities (26% of that group). High-risk individuals were characterised by low physical activity, negative dietary patterns, and the majority were overweight. It is likely that their adaptive mechanisms exhibit excessive reactivity even to minimal stressors, as reported by several authors [1, 6, 9, 10], and therefore require comprehensive rehabilitation and psychocorrection. According to Tilov B. et al., individuals with critically low PA have a significantly increased risk of developing chronic mental disorders, necessitating multidisciplinary intervention [8].

Our research findings are consistent with the current understanding of the role of physical activity, dietary behaviour and optimal body weight in shaping students' physical activity levels in relation to the learning process under conditions of chronic stress [1, 3, 8, 10, 12, 13, 17]. The significance of the differences between the sports and non-sports groups (the difference in PA is 16.6 points, indicating that individuals of sports specialties perform 39% better) demonstrates the profound impact of systematic physical training on psychophysiological functions ($p < 0.05$).

Particularly noteworthy is the fact that, within the sports group, even students with low levels of physical activity demonstrated significantly better muscle strength and a lower BMI than students from the non-sports group with high levels of physical activity. This confirms that basic physical training provides lasting protection against the threshold beyond which maladaptation develops [1, 3, 12].

The negative correlation between BMI and PA ($r = -0.51$) that we have established is particularly significant, as it indicates that BMI influences adaptation through multiple mechanisms: metabolic, immune, neuroendocrine and autonomic [4–6, 8, 12, 13]. Comprehensive measures aimed at optimising body weight through a combination of physical activity and the normalisation

of dietary behaviour have significant potential for the comprehensive improvement of the psychophysiological status of students studying under the challenging conditions of martial law.

A particularly worrying finding was the high proportion of students at high risk of developing maladaptive reactions (13.2% of the total sample, or 26.3% of the non-sports group) and with critically low levels of PA. The researchers note that uncontrolled chronic stress leads to the development of cardiovascular diseases and mental disorders. Our findings are consistent with the literature on the negative impact of chronic stress on the psychophysiological status of young people [1–3, 9, 17, 18].

It is known from the literature that aerobic physical activity may even lengthen telomeres and reduce biological ageing in individuals experiencing chronic stress [1]. This confirms the fundamental importance of integrating physical activity into health preservation programmes. This is also emphasised by other researchers, whose studies demonstrate the significance of digital interventions for stress management [3, 17, 18].

Naturally, the studies we conducted and the results obtained cannot fully resolve the problem of the relationship between morphological characteristics and PA, which requires further investigation. At the same time, based on the identified findings and established patterns, we developed a number of practical recommendations that may be implemented in higher education institutions in order to optimise the level of PA among students in accordance with potential levels of maladaptation risk.

*For students of the low-risk group for psychophysiological disorders, we propose:*

- Implementation of comprehensive psychohygiene and stress prevention programmes, including training in stress resistence and the development of adaptive coping strategies through regulated physical activity and educational initiatives on healthy nutrition;
- Inclusion of practical modules on emotional regulation and the development of metacognitive skills in academic curricula;
- Regular monitoring of students' psychophysiological status using validated computerised methods;
- Ensuring access to sports infrastructure and creating conditions for regular physical activity (at least 150 minutes of moderate aerobic activity per week).

*For students of the medium-risk group, it is advisable to:*

- Develop individualised programmes to enhance physical activity with gradual increases in intensity (starting from 30 minutes of moderate activity three times per week with a gradual increase to 150 minutes per week);
- Provide individual and group consultations with a dietitian to normalise dietary behaviour;
- Offer recommendations on sleep hygiene (7–8 hours per night at fixed times) and assess sleep quality;
- Conduct group sessions involving relaxation techniques, breathing exercises, and progressive muscle relaxation.

*For students of the high-risk group, we recommend:*

- Implementation of comprehensive rehabilitation programmes under the supervision of a multidisciplinary team (psychologists, physical rehabilitation specialists, and dietitians);
- Provision of individual psychocorrective and psychotherapeutic sessions (cognitive behavioural therapy, dialectical behavioural therapy) for the treatment of anxiety disorders and depressive symptoms;
- Development of adapted physical activity programmes tailored to current physical and mental condition and potential contraindications;
- Recommendation of protein- and micronutrient-enriched dietary programmes with reduced intake of processed foods, sugar, and stimulant beverages;
- Use of biofeedback methods, relaxation techniques, and meditative practices (breathing exercises, progressive muscle relaxation, mindfulness meditation, yoga) to normalise autonomic responses and reduce baseline activation levels;

We also recommend providing psychosocial support to learners of all groups and involving family members and relatives in the rehabilitation process.

**Conclusions:**

1. The level of psychophysiological adaptation (PA) in students is the result of an integrated interaction of neuroendocrine, autonomic, and somatic mechanisms, modulated by behavioural factors and environmental conditions. Students of sports specialities were characterised by significantly higher PA levels (59.4 ± 2.1 points) compared to the non-sports group (42.8 ± 1.9 points; $p < 0.05$), which convincingly demonstrates the fundamental role of regular physical activity in shaping adaptive potential. Particularly indicative is the fact that 92.1% of the sports group demonstrated adequate PA (high and medium levels), whereas only 44.7% of the non-sports group reached such levels, emphasising the crucial role of systematic physical training.
2. A statistically significant negative correlation of moderate strength was established between BMI and PA ($r = -0.51$, $p < 0.01$): students with normal BMI (18.5–24.9 kg/m²), regular physical activity (≥150 minutes per week), adequate sleep, and rational nutrition demonstrated higher stress resistance and more balanced adaptive mechanisms. 32% of students with normal BMI exhibited high PA levels, whereas only 12% of those who were overweight did so, indicating a direct relationship between optimal body weight and adaptive capacity.
3. Students with insufficient physical activity and unbalanced nutrition were characterised by significantly lower PA levels and demonstrated maladaptive behavioural patterns, including social avoidance and emotional overeating, whereas individuals with high PA exhibited more effective coping strategies for chronic stress and better social adaptation, indicating the critically important role of lifestyle in mental health development.
4. The distribution of participants according to risk profiles of psychophysiological disorders revealed three distinct categories: low risk of maladaptation (high and medium PA), medium risk (low PA), and high risk (critically low PA). Individuals at high risk of maladaptation require comprehensive psychocorrective interventions, including physical activity programmes, nutritional normalisation, and psychological support, particularly in the context of wartime conditions. A critically important observation is that no individual from the sports group fell into the high-risk category, confirming the protective effect of systematic physical activity against maladaptive processes.

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***Коваль К. Г., Хоменко С. М., Юхименко Л. І.***

***РОЛЬ ФІЗИЧНОЇ АКТИВНОСТІ ТА ХАРЧУВАННЯ У ФОРМУВАННІ ПСИХОФІЗІОЛОГІЧНОЇ АДАПТАЦІЇ СТУДЕНТІВ ДО НАВЧАЛЬНОГО ПРОЦЕСУ В УМОВАХ ВОЄННОГО СТАНУ***

*Метою дослідженняч було встановлення взаємозв'язків між ПА та поведінковими чинниками (ІМТ, фізична активність, особливості харчової поведінки) у студентської молоді та розроблення практичних рекомендацій щодо оптимізації психофізіологічного стану в умовах хронічного стресу. У дослідженні взяли участь 76 практично здорових здобувачів вищої освіти Черкаського національного університету імені Богдана Хмельницького віком 17-28 років (чоловічої статі): 38 студентів ННІ фізичної культури, спорту і здоров'я різних спортивних спеціальностей та 38 студентів факультетів психології та обчислювальної техніки, інтелектуальних та управляючих систем, а також ННІ педагогічної освіти, соціальної роботи і мистецтва неспортивних спеціальностей.*

*У результаті дослідження виявлено залежність ПА від ІМТ, рівня фізичної активності та якості харчової поведінки. Встановлено, що студенти спортивних спеціальностей характеризувалися значно вищим рівнем ПА (59.4 ± 2.1 балів) порівняно зі студентами неспортивних спеціальностей (42.8 ± 1.9 балів; $p < 0.05$). Встановлено негативну кореляцію середньої щільності між ІМТ та рівнем ПА ($r = -0.51$, $p < 0.01$), яка свідчить про те, що контроль маси тіла шляхом поєднання фізичної активності та нормалізації харчування має значний потенціал для поліпшення психофізіологічного стану. Студенти з нормальним ІМТ мали вищі показники ПА (32% з високим рівнем ПА) порівняно з особами з надлишковою масою тіла (12%; $p < 0.05$). Виділено три профілі ризику розвитку дезадаптації: низький (85.5%), помірний (8.0%) та високий (13.2%), представники якого потребують застосування корекційних заходів.*

*Обґрунтовано, що комплексні міждисциплінарні заходи, які включають тренінги зі стрес-менеджменту, програми фізичної активності, дієтологічне консультування та психологічну підтримку, є особливо необхідними в умовах воєнного стану.*

***Ключові слова:*** *психофізіологічна адаптація, індекс маси тіла, фізична активність, харчова поведінка, хронічний стрес, стресостійкість, воєнний стан.*

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