

PERCEIVED STRESS AND LEARNING-RELATED COGNITIVE MEASURES AMONG UKRAINIAN STUDENTS DURING THE WAR: IMPLICATIONS FOR HIGHER EDUCATION

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Abstract. The ongoing Russian invasion of Ukraine has created unprecedented psychological and educational challenges for students in Ukrainian universities. Understanding how war-related stress affects learning is essential for developing effective pedagogical strategies that support students' academic success under crisis conditions. This case study investigated the relationship between perceived stress and learning-related cognitive performance among 36 biochemistry students at Vasyl Stefanyk Carpathian National University (Ivano-Frankivsk, Ukraine) during February 2026. Perceived stress was assessed using the Perceived Stress Scale (PSS-10), while attention, concentration, and processing efficiency were evaluated using the Bourdon-Anfimov correction test. The PSS-10 indicated that 92% of students experienced moderate to high stress, with only 8% reporting low stress. Students with low stress levels maintained stable productivity and high accuracy, whereas students with moderate and high stress demonstrated a tendency toward reduced cognitive performance accompanied by considerable individual variability. Highly stressed students showed greater variability and a tendency toward decreased accuracy. The scientific novelty of the study lies in integrating psychological stress assessment with objective indicators of cognitive performance to examine learning-related functioning of university students during wartime in a region remote from active combat. From a pedagogical perspective, the findings highlight the importance of systematic monitoring of students' psychological well-being and cognitive readiness for learning and support the implementation of educational interventions aimed at improving academic resilience, attention, and learning effectiveness under prolonged crisis conditions.

Keywords: perceived stress, university students, wartime education, educational resilience, academic performance.

1. INTRODUCTION

The ongoing Russian invasion of Ukraine has created unprecedented psychological, social, and educational challenges for university students. Maintaining the quality of higher education under prolonged wartime conditions has become an important pedagogical challenge, requiring a better understanding of the factors that influence students' learning and academic performance (Błaszczuk et al., 2026).

The ongoing Russian-Ukrainian war, which began with a full-scale invasion on February 24, 2022, has faced the Ukrainian university students with unprecedented psychological, social, and educational challenges. Studies show that among populations who have been affected by armed conflict, the rates of anxiety, depression, and post-traumatic stress disorder (PTSD) are two to three times higher than among

those who have not been affected, with women and young people being particularly vulnerable (Carpiniello, 2023; Halabitska et al., 2025; Kuzikova et al., 2025; Polyvianaia et al., 2025). The young people at the universities are forced to bear a double burden: continuing their studies while simultaneously coping with the psychological trauma caused by the armed conflict, forced displacement, and the constant threat to their lives (Kuzikova et al., 2025; Polyvianaia et al., 2025).

Beyond its psychological consequences, the war has substantially transformed the educational environment in Ukrainian higher education institutions. Frequent air-raid alerts, interruptions to face-to-face teaching, unstable learning conditions, concerns about personal safety, and uncertainty about the future have become persistent components of students' educational experience. (Dubczak et al., 2025; Pinchuk et al., 2025; Polyvianaia et al., 2025). These factors not only affect emotional well-being but may also interfere with attention, concentration, information processing, and other cognitive functions that are essential for successful learning and academic achievement (James et al., 2023; Lupien et al., 2007; Pascoe et al., 2020; Shields et al., 2016).

Several factors have been identified as predictors of more severe mental health outcomes among Ukrainian students (Budnyk et al., 2025). These include female sex, younger age, prior trauma experiences, exposure to multiple traumatic events, experiences of assault or sexual violence, loss of loved ones, pre-existing mental health conditions, and higher social media use (Dubczak et al., 2025; Polyvianaia et al., 2025). Longitudinal and cross-sectional studies conducted during the war revealed alarming rates of psychological distress among Ukrainian university students (Korda et al., 2025; Pinchuk et al., 2025; Polyvianaia et al., 2025). According to a large-scale survey of 1,398 students conducted in late 2023, approximately 86% of respondents exhibited symptoms of depression, 66% showed anxiety symptoms, 57% reported sleep problems, and 48% met criteria for probable PTSD (Pinchuk et al., 2025). A study examining students twenty months after the start of the Russian invasion found that moderate and severe symptoms of anxiety, depression, and insomnia were reported by 20-35% participants (Polyvianaia et al., 2025). Research by Mykhaylyshyn and colleagues (Mykhaylyshyn et al., 2024) documented a concerning longitudinal trend, showing an increase in psychogenic factors related to martial law, communication disruptions, and safety concerns between 2022 and 2024. Their findings revealed a trend toward increased depression and anxiety alongside a stabilization, but not a reduction of acute stress indicators, suggesting progression to a chronic form of neurotic disorders among the student population (Mykhaylyshyn et al., 2024).

The relationship between mental health problems and academic performance is well-established (James et al., 2023; Lakhan et al., 2025; Pascoe et al., 2020). Both acute and chronic stress trigger the release of stress hormone cortisol, but lead to different outcomes. Acute stress triggers a temporary adaptive surge in cortisol, which helps boost immune function and mobilize energy, after which cortisol levels quickly return to baseline. In contrast, chronic stress leads to a prolonged elevation in cortisol levels, causing harmful effects such as immunosuppression, metabolic disorders (e.g., insulin resistance), impaired neuroplasticity, and cognitive decline (Cohen et al., 1983; Knezevic et al., 2023). Numerous studies have confirmed that moderate levels of stress can sometimes enhance focus and motivation, whereas chronic or excessive stress tends to reduce accuracy, task performance, and learning outcomes including disruptions of executive functions and attention (James et al., 2023; Pascoe et al., 2020).

In higher education, maintaining cognitive efficiency is essential for effective learning, problem-solving, laboratory work, and decision-making. Cognitive functions such as sustained attention, concentration, and processing speed directly influence students' ability to acquire new knowledge and successfully complete academic tasks (Ambrose, 2010; OECD, 2019). Therefore, evaluating cognitive performance alongside perceived stress provides valuable information for understanding students' educational functioning and for developing evidence-based pedagogical interventions aimed at improving learning outcomes under prolonged crisis conditions.

The Perceived Stress Scale (PSS-10) developed by Cohen et al. (Cohen et al., 1983) remains one of the most widely used instruments for measuring psychological stress. Comparative studies have

highlighted differences in stress levels between Ukrainian students and their peers in neighboring countries. Research using the PSS-10 found that 32.65% of Ukrainian students reported elevated stress levels, compared with only 4.99% of Polish students, underscoring the specific psychological burden borne by those directly affected by the conflict (Potop et al., 2024).

Although numerous studies have documented elevated levels of anxiety, depression, and post-traumatic stress symptoms among Ukrainian students, considerably less attention has been paid to objective indicators of cognitive functioning that directly affect the learning process (Halabitska et al., 2025; Lavrysh et al., 2026; Mykhaylyshyn et al., 2024; Pinchuk et al., 2025). Assessing how perceived stress relates to learning-related cognitive performance may provide educators with practical evidence to design supportive learning environments, adapt teaching strategies, and strengthen students' academic resilience during wartime. In the current context of Ukraine, students face additional psychosocial stressors that may impair their learning efficiency. Studies indicate that war exacerbates mental health issues among young people, impairing cognitive abilities and contributing to poorer academic performance (Kuzikova et al., 2025; Pinchuk et al., 2025). Regression modeling using data from Ukrainian students during the war confirms the substantial impact of mental health problems on academic productivity. Severe depression symptoms were associated with a decrease in academic performance, severe anxiety symptoms, and sleep problems (Pinchuk et al., 2025).

This case study aimed to investigate the relationship between perceived stress levels and cognitive performance among a cohort of students at Vasyl Stefanyk Carpathian National University. Although the university is located in the western region of Ukraine, far from active combat zones, students remain exposed to war-related stressors, including periodic air raid alerts, drone attacks, and missile strikes targeting civilian infrastructure.

This case study aimed to investigate the relationship between perceived stress and learning-related cognitive performance among biochemistry students at this University. By combining psychometric assessment with objective measures of attention and cognitive productivity, the study seeks to provide evidence to support the development of pedagogical strategies to promote students' academic performance, resilience, and well-being during prolonged wartime conditions. The novelty of this study lies in examining perceived stress together with objective indicators of learning-related cognitive performance among Ukrainian university students during the ongoing war. Unlike previous studies that rely primarily on self-reported mental health outcomes, the present work combines psychometric assessment with cognitive testing, providing evidence directly relevant to educational practice and the design of student support strategies in higher education.

2. METHODOLOGY AND DATA

2.1. Participants

A total of 36 bachelor's and master's students, aged 18-22, from the Department of Biochemistry and Biotechnology at Vasyl Stefanyk Carpathian National University (Ivano-Frankivsk, Ukraine) participated anonymously in the survey. Responses were not categorized by gender because 33 survey participants were female. The study was conducted in February 2026, during peak academic time, from 11:00 a.m. to 12:00 p.m., under standard classroom conditions to minimize the impact of circadian rhythm variations.

2.2. Stress assessment

Stress levels among students were assessed using a standardized psychometric instrument, namely the Perceived Stress Scale (PSS-10) developed by (Cohen et al., 1983). Respondents evaluated ten statements describing their feelings and thoughts over the past month on a five-point Likert scale (0 =

never to 4 = very often). Total scores ranged from 0 to 40 and were interpreted as follows: low stress (0–13), moderate stress (14–26), and high stress (27–40).

2.3. Cognitive function assessment

The Bourdon correction test was employed to evaluate cognitive function, specifically attention, concentration, and mental processing speed (Nedelska et al., 2020). Students were instructed to scan a letter grid for 150 s, crossing out “A” and underlining “K”. The accuracy index was calculated as the percentage of correctly selected characters versus the total number of characters processed. Productivity index, or error-corrected processed speed, was calculated as the number of correctly selected characters per minute. The association between stress levels and cognitive performance indicators was made for each.

2.4. Statistical analysis

GraphPad Prism was used for statistical analysis, calculations, and graphing. Data are presented as absolute values or mean values $\pm$ standard deviation. All normally distributed data were subjected to one-way ANOVA followed by the post-hoc Tukey’s test. Non-normally distributed data were expressed as boxplots and analyzed using the Kruskal-Wallis test followed by pairwise comparisons with the Mann-Whitney test.

3. RESULTS AND DISCUSSION

University students regularly face various stressors, including academic load, performance pressure, financial uncertainty, and sociocultural adjustment. Research consistently demonstrates that elevated stress levels can impair attention, working memory, and overall productivity (Cohen et al., 1983; Lupien et al., 2007). The Perceived Stress Scale (PSS-10), developed by Cohen and colleagues (Cohen et al., 1983), remains one of the most widely used tools for assessing perceived stress in both educational and clinical contexts. Using PSS-10, we showed that the participants exhibited a wide range of stress scores, from 10 (low stress) to 39 (high stress) (Fig. 1A). Participants were divided into three groups based on stress score levels (low, 1–13; moderate, 14–26; high, 27–40). There was a significant difference between groups ($F(2, 33) = 43.99$, $P < 0.0001$). A significant portion of the group fell into the moderate- and high-stress categories. In particular, among the 36 participants, only 3 students (8%) demonstrated low stress (scores 1–13), whereas 22 students (61%) exhibited moderate stress, and 11 students (17%) showed high stress (Fig. 1B). Overall, the average stress level among participants was quite high, with many scores exceeding 28. Thus, our results show that our students currently experience significant levels of stress, with a majority falling into the moderate and high categories.

These results align with the recent studies documenting elevated psychological distress among Ukrainian university students during the ongoing war. In particular, a 2024 study at Ternopil National Medical University found that 62.5% of medical students reported stress symptoms after 18 months of conflict, with nearly 30% in the severe or extremely severe range (Korda et al., 2025). A multi-university survey in 2023 similarly reported that 48% of students screened positive for PTSD, and over one-third exhibited moderate-to-severe anxiety and depression (Polyvianai et al., 2025). War-related factors, including air alarms, infrastructure damage, and academic disruption, are identified as primary stressors, while exam-related stress has increased significantly compared to pre-war levels (Dubczak et al., 2025).

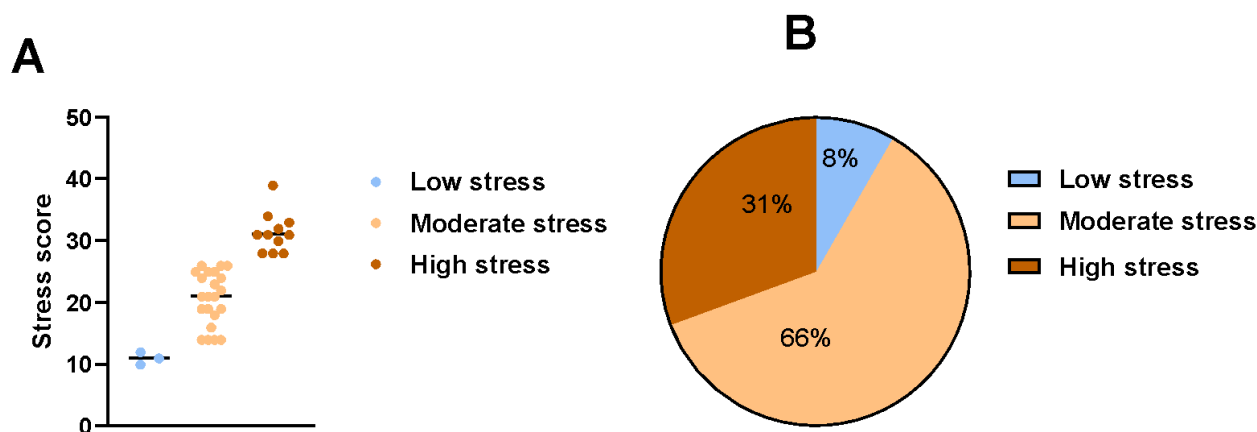


Fig. 1. Perceive stress levels in survey participants. (A) Range of total points for stress level. Values were interpreted as follows: low stress (0–13 points), moderate stress (14–26 points), and high stress (27–40 points). (B). Percentages of participants demonstrating different stress levels
Source: developed by the authors

Female students consistently report higher symptom severity, which may partly account for the elevated averages in predominantly female samples. Taken together, these findings underscore the urgent need for targeted psychological support programs for Ukrainian students navigating both academic demands and the ongoing realities of war. From an educational perspective, these findings suggest that psychological support should be integrated into the teaching and learning process rather than considered solely a health-related intervention. Universities should implement evidence-based pedagogical practices that reduce excessive cognitive load, provide flexible assessment strategies during periods of heightened stress, and strengthen students' self-regulation and learning resilience. Such measures may help preserve students' cognitive resources necessary for successful academic performance under prolonged wartime conditions.

Using a correction test, we showed that participants' average accuracy was about 89% and their average productivity index was 74% (Fig. 2A). We did not find any statistical differences in accuracy or productivity indices between groups of students with different levels of stress, $F(2, 33) = 0.1546$, $P = 0.8574$ (Fig. 2A, 2B). At the same time, in the high-stress group (scores >27), we observed a notable variance: some students maintained high productivity (e.g., a student with a stress score of 39 reached a productivity of 93%), while others showed a significant decline (e.g., a student with a stress score of 34 showed a productivity index of only 32%). The accuracy rate ranged from 46% to 100% across the moderate and high-stress groups (Fig. 2C). In some participants, higher stress levels were associated with a greater number of errors (up to 37 in one case).

Students with moderate stress maintained an average accuracy of 90–93% with slightly reduced productivity. Under high stress, accuracy dropped to ~75–80%, and productivity decreased markedly (~55–60 symbols). The data suggest that while some students exhibit high stress-resilience (maintaining productivity despite high PSS scores), the overall trend indicates that high stress levels increase the probability of errors in tasks requiring fine attention.

We found a strong positive correlation between the productivity index and the accuracy index (Pearson's $r = 0.7509$, $p < 0.0001$). (Fig. 2D). Thus, students who completed more work (higher productivity) also tended to make fewer errors (higher accuracy) in the correction test. It should be noted that correlation is not causation. We may suppose that motivated and high-achieving students put more effort into the assignment than low-achieving students, and this hypothesis warrants further investigation.

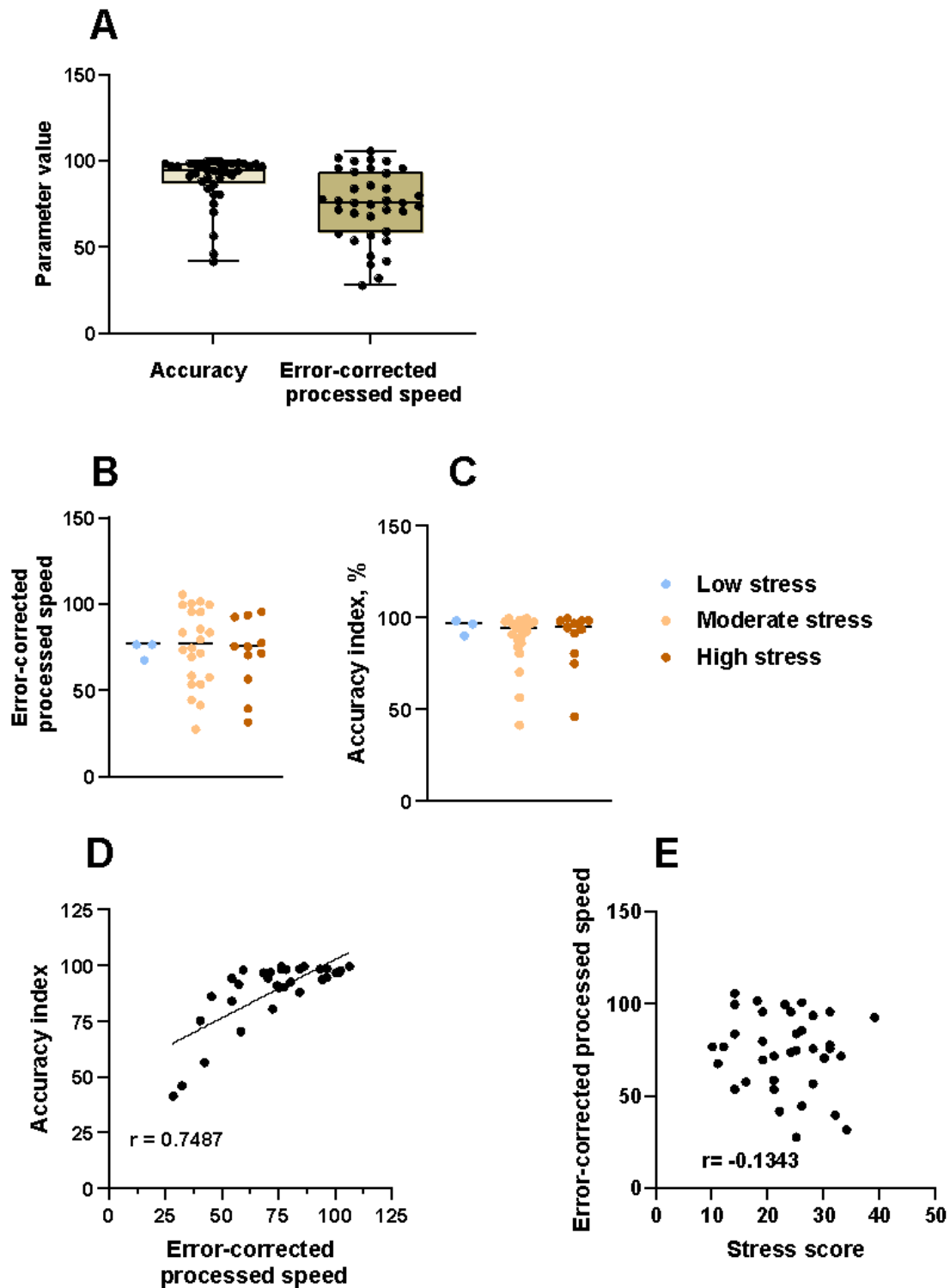


Figure 2. Productivity assessment. (A) Average accuracy index and productivity index measured as error-corrected processed speed among survey participants (B); productivity index and accuracy index among stress-allocated groups (C); correlation between (D) accuracy and productivity index; and (E) correlation between stress levels and productivity index

Source: developed by the authors

At the same time, we did not find a linear relationship between productivity index and stress levels among all participants (Fig. 2E). It should be noted that about 30% of students who demonstrated moderate stress showed higher productivity than students with low stress levels (Fig. 2C). These findings align with earlier studies that have highlighted an inverted-U relationship between stress and

cognitive performance (Lupien et al., 2007; Yerkes & Dodson, 1908). Moderate stress may enhance alertness, but prolonged or severe stress impairs concentration and visual discrimination tasks. Given that our participants were engaged in intense academic programs, maintaining moderate stress might be functional for short-term performance, but sustained high stress would likely compromise both mental health and academic output. Low-stress students maintained stable productivity and high accuracy (~96.8%), while high-stress students showed both reduced mean performance and marked individual variability. This variability aligns with research indicating that stress resilience factors, including coping style, perceived control, and social support, modulate the stress-performance relationship (Kalisch et al., 2024). Our findings align with the Attentional Control Theory (Eysenck et al., 2007), which suggests that stress consumes processing resources, leading to decreased efficiency in tasks requiring high concentration. The increase in errors and decline in processing speed among highly stressed students is consistent with evidence that chronic stress impairs prefrontal executive functions, including working memory and sustained attention (Eysenck et al., 2007; Shields et al., 2016). These findings underscore that, while some students may compensate for high stress through adaptive coping, a substantial proportion experience meaningful cognitive decrements. The observed individual variability also indicates that students respond differently to prolonged stress, emphasizing the importance of individualized educational support. Regular monitoring of stress and learning-related cognitive functioning may assist teachers in identifying students at risk of declining academic performance and adapting instructional methods accordingly. These findings contribute to educational practice by supporting the development of student-centered approaches that promote psychological well-being, spiritual development (Vasianovych et al., 2023), and effective learning in higher education during wartime.

4. CONCLUSIONS

This case study demonstrated that most biochemistry students at Vasyl Stefanyk Carpathian National University experienced moderate to high levels of perceived stress despite studying in a region relatively distant from active combat. Elevated stress was associated with reduced accuracy and greater variability in learning-related cognitive performance, although no statistically significant differences between stress groups were observed. From a pedagogical perspective, these findings indicate that prolonged wartime stress may influence students' capacity to maintain attention and cognitive efficiency during learning activities. The results support the need for higher education institutions to integrate regular monitoring of students' psychological well-being into the educational process and to implement evidence-based teaching practices that enhance academic resilience, adaptive learning, and student engagement.

The study contributes to higher education research by providing empirical evidence linking perceived stress with cognitive functions directly related to learning under wartime conditions, thereby offering practical guidance for educators seeking to improve educational quality and student support during prolonged crises.

4. LIMITATIONS

The present study has several limitations. The sample size is relatively small, limiting generalizability. Additionally, we did not assess potential confounding variables such as pre-existing mental health conditions, socioeconomic status, or direct war exposure (e.g., displacement, loss of family members), which may influence both stress levels and cognitive outcomes. Future research could expand the sample size and examine gender or year-of-study differences. Comparative research across institutions at varying distances from active conflict zones would further clarify how other factors shape psychological burden in Ukrainian students.

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Visualization: Maria Bayliak.

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Збройна агресія Росії, що триває, створила безпрецедентні психологічні та освітні виклики для студентів українських закладів вищої освіти. Розуміння того, як стрес, пов'язаний з війною, впливає на процес навчання, є надзвичайно важливим для розробки ефективних педагогічних стратегій, що сприяють академічній успішності студентів у кризових умовах. У цьому дослідженні вивчався взаємозв'язок між рівнем сприйнятого стресу та когнітивними показниками, пов'язаними з навчанням, серед 36 студентів-біохіміків Карпатського національного університету імені Василя Стефаника (Івано-Франківськ, Україна) у лютому 2026 року. Рівень сприйнятого стресу оцінювали за допомогою Шкали сприйнятого стресу (PSS-10), а увагу, концентрацію та ефективність обробки інформації — за допомогою корекційного тесту Бурдона-Анфімова. Результати PSS-10 показали, що 92 % студентів відчували стрес від помірного до високого рівня, тоді як лише 8 % повідомили про низький рівень стресу. Студенти з низьким рівнем стресу зберігали стабільну продуктивність та високу точність, тоді як студенти з помірним та високим рівнем стресу демонстрували тенденцію до зниження когнітивних показників, що супроводжувалася значною індивідуальною варіабельністю. Студенти з високим рівнем стресу демонстрували більшу варіабельність і тенденцію до зниження точності. Наукова новизна дослідження полягає в поєднанні оцінки психологічного стресу з об'єктивними показниками когнітивної працездатності для аналізу діяльності студентів, пов'язаної з навчанням, у воєнний час у регіоні, віддаленому від активних бойових дій. З педагогічного погляду, отримані результати засвідчують важливість систематичного моніторингу психологічного благополуччя студентів та їхньої когнітивної готовності до навчання, а також підтверджують доцільність впровадження освітніх заходів, спрямованих на підвищення академічної стійкості, уваги та ефективності навчання в умовах тривалої кризи.

Ключові слова: сприйнятий стрес, студенти університету, освіта в умовах війни, стійкість освітньої системи, навчальні результати.