

The potential of adventure tourism as a means of preventing stress-related states in students during wartime

Olena Andrieieva^a, Nataliia Byshevets^b, Vitalii Kashuba^c,
Tamara Loshytska^d, Nataliia Golovanova^e

^aDepartment of Health, Fitness and Recreation, National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

<https://orcid.org/0000-0002-2893-1224>

^bDepartment of eSports and information technologies, National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

<https://orcid.org/0000-0001-6118-6580>

^cDepartment of kinesiology and physical culture and sports rehabilitation, National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

<https://orcid.org/0000-0001-6669-738X>

^dDepartment of Human Health and Physical Culture, Mykhailo Ostrohradsky National University of Kremenchug, Kremenchug, Ukraine

<https://orcid.org/0000-0002-2361-3307>

^eDepartment of eSports and information technologies, National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine

<https://orcid.org/0000-0002-8837-7501>

Corresponding Author: Olena Andrieieva

e-mail: olena.andreeva@gmail.com

Abstract.

Purpose. To assess the effectiveness of using adventure tourism for the prevention of stress-related states in students during wartime.

Materials and methods. The study involved 30 students who took part in short-term adventure programs organized during wartime (October 10-26, 2023 and May 22-28, 2024) in Ukraine. The age of the participants was 22.0 (20.0; 31.0) years. Of these, 73.3% were male and the rest were females. 73.3% lived in Kyiv and Kyiv region, the rest were from Lviv, Dnipro, and Khmelnytskyi. 66.7 % indicated that they had no negative experience of being directly in the area of active hostilities. A sample of 194 students from the main group of 1901 students who took part in the study during the same period as the participants of the adventure program was used as a comparison group. Inclusion criteria: studying in a higher education institution in Ukraine; motivation to participate in a short-term adventure program; voluntary consent to participate in the study; and medical clearance. The study used a short version of the questionnaire 'Reaction of Ukrainian students to hostilities in the country' that was developed using Google Forms at the National University of Physical Education and Sports of Ukraine supplemented by the question "How did participation in the

adventure program affect your condition? In addition to a block of demographic information questions, the questionnaire included blocks of questions aimed at determining psychophysiological indicators (activity, mood, sleep, appetite, performance, and well-being; measured with the 5-point Likert scale from 1 (very poor) to 5 (very good); Cronbach's alpha – 0.837); factors that can enhance or mitigate the impact of military stress (gender: male – 1 and female – 0; participation in the adventure program – Yes, comparison group – No; measured with a categorical scale); stress assessment by V. Y. Shcherbatykh (measured with a ratio scale); anxiety scores were assessed using the Spielberg-Hanin Inventory and the risk of PTSD was assessed using the Mississippi Scale (measured with an ordinal scale).

Results. The study analyzed the impact of short-term adventure programs on reducing stress, anxiety, and the risk of post-traumatic stress disorder (PTSD) in students during wartime. Using GLM modeling, it was found that participation in the program is a statistically significant predictor of an increase in all three indicators ($p < 0.05$). At first glance, this seems to contradict the intuitive expectation of effects from such a program. However, when gender was taken into account, the opposite trend was observed: unlike female students, in male students, participation in the program was associated with a significant reduction in stress, anxiety, and the risk of PTSD. The program had a particularly significant impact on reducing the risk of post-traumatic stress disorder: the reduction was 1.35 standard deviations.

Conclusions. This study is one of the first to examine the impact of adventure tourism on students' mental health during wartime and makes a new contribution to understanding the mechanisms of influence of extreme physical activities on stress-related states in higher education students. Significant gender differences in the impact of short-term adventure programs were found: while male students showed a significant reduction in stress, anxiety, and risk of PTSD, female students, on the contrary, had higher scores of stress-related states. The results of the study demonstrate that participation in the program had the greatest impact on reducing the risk of developing PTSD in male students, which emphasizes its potential as an effective preventive intervention. The data obtained can act as a starting point for further research on gender differences in reactions to military stress and extreme types of PA, as well as their impact on stress-related states in higher education students

Keywords: extreme physical activities, adventure tourism, young people, stress-related state, effect.

Introduction

Despite the proven effectiveness of physical recreation activities in reducing stress and depression (Andrieieva et al, 2022; Hakman, et al, 2019; Kim et al, 2014; Nguyen-Michel et al, 2006; Powell et al, 2022; Steinacker et al, 2023), a significant part of Ukrainian youth affected by war has limited access to traditional forms of physical activity (PA) (Andrieieva et al, 2024). Constant stressful situations during wartime, such as air raid alarms, social instability, and losses, lead to the depletion of students' psychological resources, which requires the search for new, more adaptive approaches to preventing their stress-related states.

Adventure tourism, which combines PA, outdoor activities, and social interaction and is

characterized by a higher risk and more emotionality compared to other types of active leisure, can be a promising tool for overcoming the effects of military stress. It is believed that participation in adventure travels promotes the production of endorphins, distraction from negative thoughts, development of coping skills, and strengthening of social ties (Brymer et al, 2020; Chang et al, 2018; Chen et al, 2024). However, the question of the effectiveness of this type of activity for students during wartime, especially taking into account their psychophysiological indicators and gender, remains insufficiently researched.

Literature analysis shows that adventure tourism helps prevent stress in college students through the development of their stress resistance,

i.e. the ability to withstand stressful situations or recover from them (Allan, McKenna, 2019; Ilagan, et al, 2022), and to release and transform the negative energy that accumulates in the process of increasing depression and anxiety and to point it in a positive direction.

Scientists are actively discussing the ability of adventure tourism to promote the development of stress resistance in college students and indicate the reduction of their psychological and physiological stress (Chang et al, 2018). The authors report a statistically significant ($p < 0.05$) reduction in stress and depression symptoms in participants of adventure programs that included hiking, outings, swimming, climbing and camping (Karisman, Supriadi, 2020). Researchers emphasize that the positive effects on students' mental health come from pushing personal boundaries, fighting fear, increasing body awareness, building interpersonal relationships, and connecting more deeply with nature through risk-taking and emotional outbursts (Karisman, Supriadi, 2020). Furthermore, adventure tourism is associated with stress. Psychologists distinguish between positive stress (eustress) and negative stress (distress), the manifestation of which is associated with the release of different hormones (adrenaline or cortisol) and is accompanied by a surge of various emotions (depression, fear, panic or euphoria, joy, excitement, and arousal). Summarizing the literature and our own experience of participating in short-term outdoor adventure programs, we have suggested that participation in adventure programs allows students to experience significant positive stress, which can suppress negative stress. In contrast to the studies aimed at determining the effectiveness of short-term adventure programs in reducing the manifestations and consequences of stress in college students, this issue has not been sufficiently covered. Scientists prove the positive effect of adventure tourism on students' perceived stress, but at the same time, the reasons why this happens remain out of their attention, which is explained by the difficulty of identifying informative markers and measuring types of stress

from a physiological point of view. Nevertheless, there are some articles that can, to some extent, confirm our assumptions.

By investigating the mechanisms of stress, N. Kamaruddin (2021) proposed to measure positive and negative stress using electroencephalography, which involves recording electrical activity in the frontal and central regions of the brain to obtain information about human emotions. The author expects that in the future, this approach will allow to identify the correlation between emotions and stress.

C.-T. Li et al (2016) obtained results on the prospects for diagnosing positive stress in college students based on data on their heart rate variability, which the scientist determined using sensors, smartphones, and computers. According to the author, on the one hand, positive stress combines moderate stress with high performance, and, on the other hand, moderate stress with good mood. This approach opens up prospects for distinguishing between positive and negative stress based on behavioral factors. In students, there is a statistically significant direct correlation between positive and negative stress ($r = 0.967$; $p < 0.05$), anxiety and self-efficacy ($r = 0.743$; $p < 0.05$), and self-efficacy and academic performance ($r = 0.635$; $p < 0.05$). A. Serpa-Barrientos et al (2023) proved an inverse correlation between the types of stress, as well as their positive and negative impact on students' stress resistance, which, in turn, directly affects the risk of PTSD. Data on the relationship between types of stress in students remain controversial. Since adventure tourism can be a powerful source of positive emotions and, consequently, positive stress, the study of its impact on the stress-related states in higher education students deserves special attention.

Purpose of the study. To assess the effectiveness of using adventure tourism for the prevention of stress-related states in students during wartime.

Hypotheses of the study. Given the assumption that short-term positive stress caused by adventure tourism can be effective in preventing

stress-related states in students, the hypothesis “Conscious participation in an adventure program, regardless of gender, reduces stress, anxiety, and the risk of PTSD in higher education students” was formulated and tested.

Materials and methods.

Study participants.

The study involved 30 students who took part in short-term adventure programs organized during wartime (October 10-26, 2023 and May 22-28, 2024) in Ukraine. The age of the participants was 22.0 (20.0; 31.0) years. Of these, 73.3% were male and the rest were females. 73.3% lived in Kyiv and Kyiv region, the rest were from Lviv, Dnipro, and Khmelnytskyi. 66.7 % indicated that they had no negative experience of being directly in the area of active hostilities. A sample of 194 students from the main group of 1901 students who took part in the study during the same period as the participants of the adventure program was used as a comparison group. This approach was used due to the intention to eliminate the influence of temporal changes: in 2022-2023, there were significant changes in the socio-economic situation, which could affect the psychological state of students. Limiting the sample allowed us to minimize the impact of these changes. In addition, such approach increases the comparability of groups, which will make the comparison more representative. In addition, it increases the internal validity of the study, i.e., we can state with greater confidence that the differences found between the groups are related to participation in the adventure program, and not to other factors.

Inclusion criteria: studying in a higher education institution in Ukraine; motivation to participate in a short-term adventure program; voluntary consent to participate in the study; and medical clearance.

Study organization. The study used a short version of the questionnaire ‘Reaction of Ukrainian students to hostilities in the country’ that was developed using Google Forms at the National University of Physical Education and Sports of Ukraine supplemented by the question “How did

participation in the adventure program affect your condition?”. In addition to a block of demographic information questions, the questionnaire included blocks of questions aimed at determining psychophysiological indicators (activity, mood, sleep, appetite, performance, and well-being; measured with the 5-point Likert scale from 1 (very poor) to 5 (very good); Cronbach’s alpha – 0.837); factors that can enhance or mitigate the impact of military stress (gender: male – 1 and female – 0; participation in the adventure program – Yes, comparison group – No; measured with a categorical scale); stress assessment by V. Y. Shcherbatykh (measured with a ratio scale); anxiety scores were assessed using the Spielberg-Hanin Inventory and the risk of PTSD was assessed using the Mississippi Scale (measured with an ordinal scale).

The adventure tourism program was designed for seven days. In total, the participants covered a distance of 110 km (an average of 15.7 km per day, approximately 7-8 legs a day with breaks for rest every 30-40 min lasting 10-15 minutes and for meals. The start backpack weight varied depending on gender and averaged 23-28 kg. Furthermore, the programs included other activities, such as orienteering, recreational games, organizing a bivouac, etc.

Statistical analysis. Since the sample of students who prefer adventure tourism was dominated by males, gender weighting was used to eliminate bias due to the uneven distribution of genders in the sample. This allowed for more accurate estimates of statistics, and the results obtained after weighting can be generalized to the entire student population with greater confidence.

The use of descriptive statistics was preceded by testing the hypothesis of a normal distribution of the input data using the Shapiro-Wilk W test, which is most powerful for samples of up to 50 observations. Since such hypotheses were not confirmed in any case, measures of the central tendency and scatter of the studied indicators were presented using robust characteristics, namely the median Me and the 1st and 3rd quartiles, which are

less sensitive to outliers and deviations from the normal distribution, in the form of Me (25%; 75%).

The Mann-Whitney U test was used in the comparative analysis. Since there were coinciding values in the data set and when the samples have very different sizes, to avoid distorting the distribution of the U-statistic, an adjusted Z-score was used to account for this and provide a more accurate distribution and p-value.

GLM-modelling. Generalized linear models (GLMs) were used to predict stressful states in university students using continuous dependent variables (stress, anxiety, and the risk of PTSD). Categorical variables (gender and participation in the adventure program) and ordinal variables

(sleep, activity, appetite, mood, well-being, and work capacity) were used as predictors. To eliminate the gender imbalance in the group of program participants, which consisted of 73.3% males and 26.7% females, all numerical indicators were adjusted. The data were multiplied by the coefficient 0.682 (50/73.3) for males and 1.873 (50/26.7) for females, which allowed to balance the indicators and make the results comparable to the comparison group, which has an even gender distribution (50% males and 50% females).

The dependent variables were scores of stress, anxiety, and the risk of PTSD expressed in points. The description of the independent variables is given in the table (Table 1).

Table 1. Description of independent variables (predictors)

Predictors	Description	Value range	Coding
V1	Gender	male / female	1/0
V2	Participation in the adventure program	Yes / No	1/0
V3	Activity	1~5, points	Without encoding
V4	Sleep	1~5, points	Without encoding
V5	Mood	1~5, points	Without encoding
V6	Appetite	1~5, points	Without encoding
V7	Working capacity	1~5, points	Without encoding
V8	Well-being	1~5, points	Without encoding

The level of statistical significance was 0.05 ($p < 0.05$). Calculations were performed using STATISTICA software (StatSoft, USA).

Results

The study found that a significant number of Ukrainian higher education students faced psychological difficulties as a result of the hostilities. 60% of respondents said they had experienced the negative impact of the war. The most common stress-related states reported by students before participating in the adventure program were mood swings (43.3%), anxiety (30%), and depression (16.7%). Only 6.7% of respondents categorically denied having such symptoms. These data indicate a high level of psychological stress in students during wartime. It is worth noting that despite the difficult

circumstances, 86.6% of the respondents continued to systematically engage in PA. However, 10% of students resorted to taking sedatives, and 20% observed an increase in bad habits.

Comparing the results with previous studies, we found that students who prefer extreme activities demonstrate greater resistance to the stress associated with military activities. They are less likely to turn to harmful ways of coping with stress and more likely to choose healthy strategies such as PA.

It was found that participation in the short-term adventure program contributed to increased psychophysiological indicators, especially in terms of activity, the median of which was 4.5 (3.0; 5.0) points. However, after weighting for gender, it turned out that in the comparison group,

psychophysiological indicators exceeded the results for the group of students who participated in the

adventure program (Table 2).

Table 2. Psychophysiological indicators of students depending on participation in the short-term adventure program (n=224)

Parameter	Central tendency and scatter						Comparative analysis using the Mann-Whitney U test		
	adventure tourism (n=30)			comparison group (n=194)			U	Z	p
	Me	25 %	75 %	Me	25 %	75 %			
Activity	3.0	2.0	7.0	4.0	3.0	5.0	2339.0	-1.787	0.0740
Sleep	3.0	2.0	4.0	3.0	2.0	4.0	2898.5	0.034	0.9726
Mood	3.0	2.0	3.0	3.0	3.0	4.0	2561.5	-1.098	0.2722
Appetite	3.0	3.0	4.0	4.0	3.0	5.0	2369.0	-1.690	0.0910
Working capacity	3.0	3.0	4.0	4.0	3.0	5.0	2385.5	-1.641	0.1007
Well-being	3.0	2.0	3.0	3.0	3.0	4.0	2365.5	-1.713	0.0868
Stress	9.9	5.7	18.5	15.5	8.5	25.0	2193.5	-2.171	0.0299
Anxiety	30.5	30.0	52.0	44.0	42.0	46.0	2233.0	-2.048	0.0405
Signs of PTSD	57.5	56.0	144.0	83.0	73.0	97.0	1574.5	-4.054	0.0001

Note: weighted indicators of the group that took part in the short-term adventure program are presented.

Instead, the scores of stress, anxiety, and signs of PTSD in the group that participated in short-term adventure programs were statistically

significantly ($p < 0.05$) lower. This indicates that they mitigated stress-related states under the influence of this type of activity (Fig. 1).

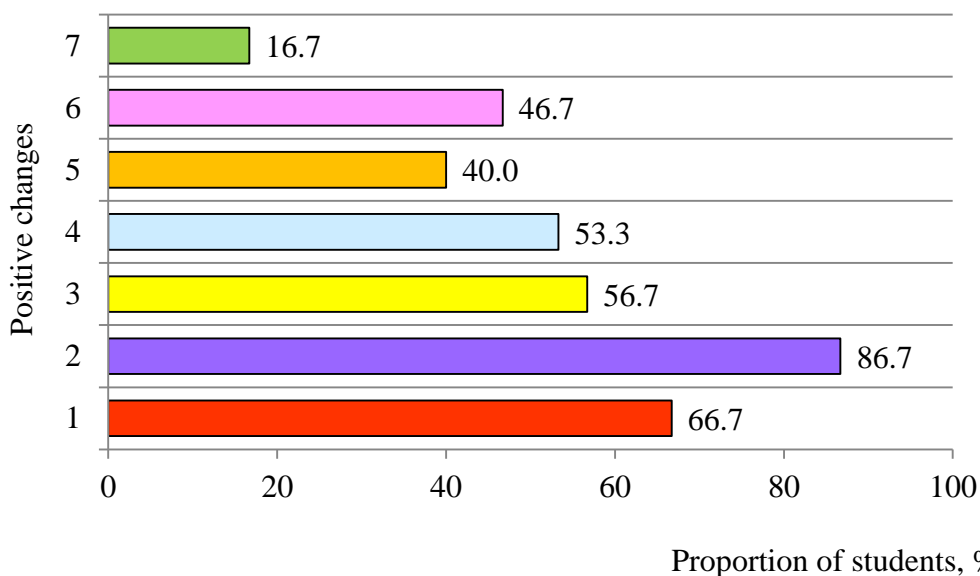


Figure 1. Positive changes in students under the influence of participation in the adventure program (n=30), where: 1 – reduced stress level; 2 – improved mood; 3 – improved physical condition; 4 – getting rid of heavy, obsessive thoughts; 5 – restored mental balance; 6 – improved stress resistance; 7 – other

It was found that students who took part in short-term adventure programs showed better results in terms of all stress-related states than

students from the comparison group. In contrast, female students showed exactly the opposite results (Fig. 2).

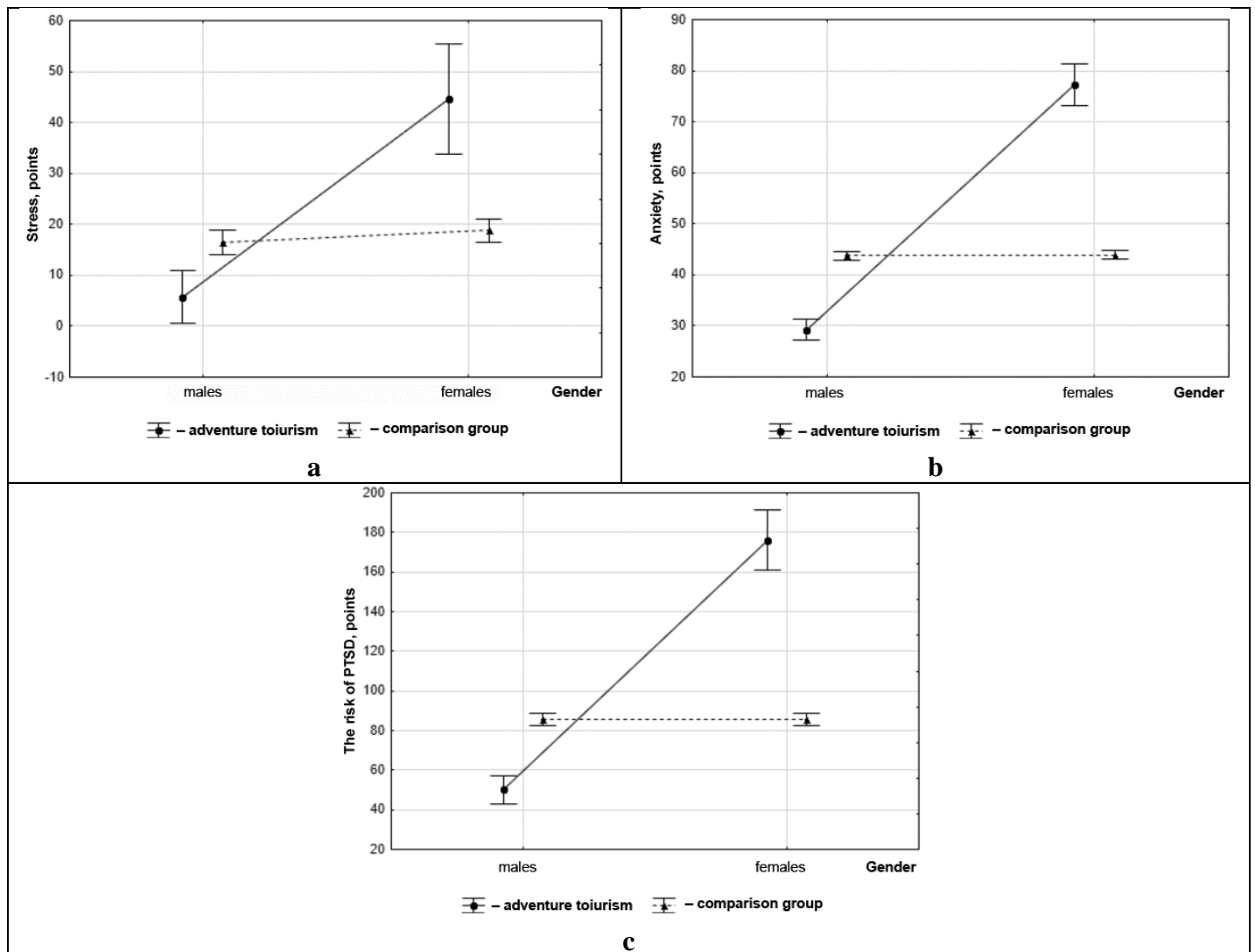


Figure 2. Specific features of the impact of adventure tourism on stress-associated states in students depending on gender, where a – stress; b – anxiety; c – the risk of PTSD

GLM modeling showed that the prediction of stress-related states in higher education students statistically significantly depends on participation in a short-term adventure program, gender, and a combination of group*gender factors. All the models built, “Stress”, “Anxiety”, and “Risk of PTSD”, were statistically significant ($p < 0.05$). The percentage of total variation explained by the model “Stress” was 20.3% ($R^2 = 0.203$; $F = 6.071$; $p < 0.05$) and by the “Risk of PTSD” was 55.6% ($R^2 = 0.556$; $F = 6.071$; $p < 0.05$). However, the model for predicting anxiety was especially good as it explained 77.8% of the variation in the data ($R^2 = 0.778$; $F = 6.071$; $p < 0.05$).

The “Stress” model revealed several statistically significant predictors. The beta coefficients for these predictors indicated their influence on stress levels. It should be noted that appetite and stress were directly related, which is

consistent with the literature. For instance, a 1-point increase in appetite is associated with a 0.18 standard deviation increase in stress. In contrast, a 1-point increase in sleep quality reduces stress by 0.23 standard deviations. The group of adventure program participants was characterized by a level of stress higher by 0.20 ($p < 0.05$) standard deviations compared to the control group due to increased stress in female students participating in adventure programs. It was found that the effect of participation in adventure programs on stress levels differed depending on gender, when, unlike female students, the involvement of male students in such programs allowed us to predict a decrease in their stress by 0.72 standard deviations. These results emphasize the significant effectiveness of adventure tourism in reducing stress among male students (Table 3).

Table 3. Coefficients of generalized linear models for predicting stress-related states in male students (n=224)

Predictors and interactions	Regression coefficients and their estimates						Standardised coefficients			
	α	S(α)	t	p	CI		β	S(β)	CI	
					-95%	+95%			-95%	+95%
Stress ($R^2 = 0.203$; $F = 6.071$; $p < 0.05$)										
Intercept	30.83*	4.18	7.369	<0.05	22.58	39.07				
Activity	0.40	1.00	0.401	0.6885	-1.57	2.37	0.04	0.11	-0.17	0.25
Sleep	-2.07	0.85	-2.420	0.0163	-3.75	-0.38	-0.23	0.09	-0.41	-0.04
Mood	0.29	1.11	0.263	0.7928	-1.89	2.47	0.03	0.10	-0.17	0.23
Appetite	1.73*	0.82	2.105	0.0365	0.11	3.35	0.18	0.09	0.01	0.35
Working capacity	-1.52	1.03	-1.483	0.1397	-3.55	0.50	-0.15	0.10	-0.36	0.05
Well-being	-1.77	1.09	-1.618	0.1071	-3.92	0.38	-0.17	0.11	-0.38	0.04
Group	3.77*	1.46	2.573	0.0108	0.88	6.65	0.20	0.08	0.05	0.36
Gender	-10.29*	1.72	-5.974	<0.05	-13.69	-6.90	-0.81	0.14	-1.08	-0.54
Group*Gender	-9.15*	1.73	-5.289	<0.05	-12.56	-5.74	-0.72	0.14	-0.99	-0.45
Anxiety ($R^2 = 0.778$; $F = 6.071$; $p < 0.05$)										
Intercept	49.88*	1.56	32.073	<0.05	46.82	52.95				
Activity	0.70	0.37	1.883	0.0610	-0.03	1.43	0.11	0.06	-0.00	0.22
Sleep	0.02	0.32	0.051	0.9592	-0.61	0.64	0.00	0.05	-0.10	0.10
Mood	-0.94*	0.41	-2.294	0.0228	-1.76	-0.13	-0.12	0.05	-0.23	-0.02
Appetite	-0.41	0.31	-1.359	0.1757	-1.02	0.19	-0.06	0.05	-0.15	0.03

Working capacity	0.04	0.38	0.115	0.9086	-0.71	0.80	0.01	0.05	-0.10	0.11
Well-being	0.14	0.41	0.343	0.7318	-0.66	0.94	0.02	0.06	-0.09	0.13
Group	4.69*	0.54	8.628	<0.05	3.62	5.77	0.36	0.04	0.28	0.44
Gender	-12.02*	0.64	-18.775	<0.05	-13.28	-10.76	-1.35	0.07	-1.49	-1.20
Group*Gender	-11.97*	0.64	-18.608	<0.05	-13.23	-10.70	-1.34	0.07	-1.48	-1.20
Risk of post-traumatic stress disorder (R²=0.556; F=6.071; p<0.05)										
Intercept	122.66*	5.73	21.399	<0.05	111.4	133.9				
Activity	-0.07	1.37	-0.051	0.9594	-2.77	2.63	-0.004	0.08	-0.16	0.15
Sleep	-1.39	1.17	-1.184	0.2378	-3.69	0.92	-0.08	0.07	-0.22	0.06
Mood	0.10	1.52	0.063	0.9494	-2.89	3.09	0.00	0.08	-0.15	0.15
Appetite	1.84	1.12	1.634	0.1037	-0.38	4.05	0.10	0.06	-0.02	0.23
Working capacity	-1.47	1.41	-1.041	0.2990	-4.24	1.31	-0.08	0.08	-0.23	0.07
Well-being	-5.86*	1.49	-3.919	0.0001	-8.80	-2.91	-0.31	0.08	-0.47	-0.16
Group	13.75*	2.01	6.855	<0.05	9.79	17.70	0.40	0.06	0.29	0.52
Gender	-31.58*	2.36	-13.381	<0.05	-36.23	-26.93	-1.36	0.10	-1.56	-1.16
Group*Gender	-31.46*	2.37	-13.274	<0.05	-36.13	-26.79	-1.35	0.10	-1.56	-1.15

Notes: Level of the effect – group – adventure tourism; male gender;

* – coefficient is statistically significant at the p-level of 0.05

Similar results were obtained for the prediction of anxiety and the risk of PTSD. The peculiarity of these models was the influence of mood on anxiety and well-being on the risk of PTSD, which decreases with the increase in these indicators. All the models directly indicate the positive impact of the adventure program on reducing stress-related states in male students. The maximum effect of the program was observed for the risk of PTSD, which decreased by 1.35 standard deviations. The program also had an impact on anxiety, reducing it by 1.34 standard deviations. The program's effect on stress was slightly smaller (-0.72 standard deviations), but still statistically significant ($p < 0.05$).

Discussion

During wartime, higher education students experience increased stress and other stress disorders. This has been confirmed by a number of researchers (Kurapov et al, 2023; Pavlova, et al, 2024; Petrachkov et al, 2023), as well as the results of our previous studies (Andrieieva, et al, 2023, 2024; Byshevets et al, 2023, 2024). Therefore, an important area of scientific research is to identify

the most effective types of PA that can prevent stress-related states in students.

Adventure tourism activities are especially useful for students who are in a period of active personality formation, which makes them more open to new experiences and receptive to change. Physical activity, dosed stress, and goal achievement all contribute to the production of endorphins, the hormones of happiness that have analgesic and anti-inflammatory effects, improve mood and boost self-esteem. At the same time, immersion in adventure activities can switch attention from the effects of military stress, thereby mitigating the stress-related states in higher education students.

In the course of the study, in order to prevent stress disorders in students during wartime, we offered them to participate in short-term adventure programs and hypothesized that conscious participation in short-term adventure programs, regardless of gender, would prevent the development of stress-related states. However, our hypothesis was only partially confirmed.

The analysis of the study results showed a significant impact of adventure tourism on stress-related states in students, especially in interaction with gender. In each model, the effect of the program was observed that was most pronounced for male students. The beta coefficient was -0.72 (95% CI: -0.99, -0.45) for the stress level, -1.34 (95% CI: -1.48, -0.07) for anxiety, and -1.35 (95% CI: -1.56, -1.15) for the risk of PTSD. The largest absolute values of the coefficients were observed for PTSD risk and anxiety, indicating that the program had a particularly strong effect on these indicators. However, the program also had a significant positive effect on stress. Therefore, participation in the program had a particular effect on male students, by reducing their stress-related states, especially the risk of PTSD and anxiety.

The significant reduction in stress-related states among students may be explained by their better adaptation to the physical and extreme conditions offered by the adventure program. The program may have contributed to the development of skills that help students cope with stress, as well as provided opportunities for PA, which had a positive impact on their psychophysiological state.

At the same time, the indicators of female students after the intervention were worse than in the comparison group. This may be due to the fact that the program did not fully take into account their needs and characteristics. It is possible that the structure of the program or its elements caused additional stress for female students, or they faced great difficulties in adapting to its conditions due to a low level of their readiness for the travel including physical fitness. These factors may have contributed to the worsening of their stress-related states.

The expectation that extreme activity can work as a powerful “positive stressor” that blocks the development of stress is logical and based on personal experience. However, the results show that gender plays a significant role in the reaction to such activity in the face of a powerful stressor associated with war.

Most likely, this is due to the fact that extreme loads correspond to the usual stress adaptation mechanisms of male students, while for female students they can cause more complex reactions, possibly increasing internal strain. On the other hand, these differences may be explained by socio-cultural or psychological factors, such as a greater risk-taking tendency among male students compared to female students, as well as their less pronounced stress reactions in wartime, which we observed during our research (Andrieieva, et al, 2023, 2024; Byshevets et al, 2023, 2024).

The findings have significant practical implications. Short-term adventure programs are recommended for male students, as they have shown a significant reduction in the level of stress-related states. As for female students, in the future it is advisable to adjust the program to meet their needs, physical abilities, and individual characteristics, as well as to test the adjusted program on another group of higher education students to study its effectiveness.

Conclusions

This study is one of the first to examine the impact of adventure tourism on students’ mental health during wartime and makes a new contribution to understanding the mechanisms of influence of extreme activities on stress-related states in higher education students.

It was found that adventure tourism has a pronounced impact on students’ perception of the military stressor. Most of all, this is due to the significant physical and mental efforts that have to be overcome during such activities, as well as greater emotionality compared to other types of PA. However, significant gender differences were found in the impact of short-term adventure programs: while male students showed a significant reduction in stress, anxiety, and PTSD risk compared to the comparison group, female students, on the contrary, had higher scores for stress-related states. To better understand these gender differences, comprehensive studies that take into account both the physiological and

psychological aspects of adventure tourism-related stress are needed.

The data obtained can act as a starting point for further research on gender differences in reactions to military stress and extreme types of PA, as well as their impact on stress-related states in higher education students. In addition, it is necessary to find out what psychological mechanisms underlie the therapeutic effect of adventure tourism, as well as what organizational and security measures should be taken to ensure the widespread implementation of such programs in Ukrainian realities.

Limitations. Our study was conducted within the framework of the specialty ‘physical culture and sports’, thus the focus was on the psychophysical aspects of participation in a short-term adventure program. Therefore, it is beyond the scope of this study to confirm the assumption that powerful positive stress caused by participation in the program can displace or block the development of stress and prevent stress-related states in students during wartime. This assumption should be left for consideration by biologists, physicians, or other experts who study and measure the physiological manifestations of stress. Potential limitations of the hypotheses are as follows:

Individual differences: the reaction to a stressor may vary between participants, so

participation in adventure tourism programs may either mitigate or exacerbate stress.

Presence of other stressors: positive stress from adventure activities may not be enough to overcome the stress-related state if there are other strong stressors, such as loss or injury of loved ones, their deployment to war, destruction of housing, etc.

The use of self-reports: the use of self-reports can lead to a certain bias in the data, as participants may subjectively perceive and interpret their states in different ways.

Author’s contribution. Conceptualization, O.A. and N.B.; methodology, O.A. and N.B.; investigation, N.B, O.A., T.L., N.G; writing – review and editing, O.A. and N.B.; visualization, N.B; su-pervision, O.A. and N.B.; project administration, O.A. and V.K. All authors have read and agreed with the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

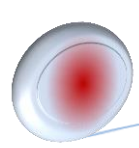
Funding sources

The work was carried out in accordance with the topic of the applied research, which is being carried out at the expense of the general fund of the state budget of the Ministry of Education and Science of Ukraine for 2024–2025.

References

- Allan, J.F., McKenna, J. (2019). Outdoor Adventure Builds Resilient Learners for Higher Education: A Quantitative Analysis of the Active Components of Positive Change. *Sports* (Basel), 21, 7 (5), 122. <https://doi:10.3390/sports7050122> .
- Andrieieva, O., Maltsev, D., Kashuba, V. et al. (2022). Relationship between quality of life and level of physical activity and family well-being. *Physical Education Theory and Methodology*, 22(4), 569–575. <https://doi.org/10.17309/tmfv.2022.4.16>
- Andrieieva, O, Byshevets, N, Kashuba, V. et al. (2024). Application of mental fitness tools in the prevention of stress-associated conditions of female students of higher education establishments. *Physical rehabilitation and recreational health technologies*, 9, 98-112. [https://doi.org/10.15391/prrht.2024-9\(3\).01](https://doi.org/10.15391/prrht.2024-9(3).01).
- Andrieieva, O., Byshevets, N., Kashuba, V., Hakman, A., & Grygus, I. (2023). Changes in physical activity indicators of Ukrainian students in the conditions of distance education. *Physical rehabilitation and recreational health technologies*, 8(2), 75-81. [https://doi.org/10.15391/prrht.2023-8\(2\).01](https://doi.org/10.15391/prrht.2023-8(2).01)

- Byshevets, N., Andrieieva, O., Goncharova, N. et al. Prediction of stress-related conditions in students and their prevention through health-enhancing recreational physical activity. *Journal of Physical Education and Sport*, 2023, 23(4), 937–943. <https://doi.org/10.7752/jpes.2023.11339> .
- Byshevets, N., Andrieieva, O., Dutchak, M. et al. (2024). The Influence of Physical Activity on Stress-associated Conditions in Higher Education Students. *Physical Education Theory and Methodology*, 24(2), 245–253. <https://doi.org/10.17309/tmfv.2024.2.08>.
- Brymer E, Feletti F, Monasterio E, Schweitzer R. (2020). Editorial: Understanding Extreme Sports: A Psychological Perspective. *Front Psychol.* 10, 3029. <https://doi:10.3389/fpsyg.2019.03029> .
- Chang, Y., Davidson, C., Conklin, S., & Ewert, A. (2018). The impact of short-term adventure-based outdoor programs on college students' stress reduction. *Journal of Adventure Education and Outdoor Learning*, 00(00), 1–17. <https://doi.org/10.1080/14729679.2018.1507831> .
- Chen, J., Chan, N.Y., Li, CT. et al. (2024). Multimodal digital assessment of depression with actigraphy and app in Hong Kong Chinese. *Transl Psychiatry.* 14, 150. <https://doi.org/10.1038/s41398-024-02873-4>
- Li, C.-T., Cao, J., & Li, T. M. H. (2016). Eustress or distress: an empirical study of perceived stress in everyday college life. Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct. 1209–1217. <https://doi.org/10.1145/2968219.2968309>
- Hakman, A., Andrieieva, O., Kashuba, V. et al. (2019). Technology of planning and management of leisure activities for working elderly people with a low level of physical activity. *Journal of Physical Education and Sport*, 19, 2159–2166. <https://doi.org/10.7752/jpes.2019.s6324>
- Ilgan, G., Ilgan, J., Jocius, R., Hornor, T., Shealy, T., Simpson, A., Cavaliere, G., Pollen, B., & Brooks J. (2022). Backpacking Veterans: Exploring Sense of Belonging, Happiness, and Stress-Coping. *Journal of Outdoor Recreation, Education and Leadership.* 4 (4), 36-54. <https://doi.org/10.18666/JOREL-2022-11600> .
- Kim, J. and McKenzie, L. (2014). The Impacts of Physical Exercise on Stress Coping and Well-Being in University Students in the Context of Leisure. *Health.* 6, 2570-2580. <https://doi.org/10.4236/health.2014.619296>..
- Kamaruddin N. (2021). Eustress and Distress Analysis Based on Neuro-Physiological Model of Affect. *Turkish Journal of Computer and Mathematics Education (TURCOMAT).* 12, 1350–1357
- Karisman, V. A., & Supriadi, D. (2020). The Effect of Short Term Adventure-Based Outdoor Program on Decreasing The Stress Level of College Students. *JPJO.* 5 (1). 76-80 DOI: <https://doi.org/10.17509/jpjo.v5i1.22584>
- Kurapov, A., Pavlenko, V., Drozdov et al. (2023) Toward an Understanding of the Russian-Ukrainian War Impact on University Students and Personnel. *Journal of Loss and Trauma*, 28, 2, 167–174, <https://doi.org/10.1080/15325024.2022.2084838>.
- Nguyen Michel, S. T., Unger, J. B., Hamilton, J., & Spruijt Metz, D. (2006). Associations between physical activity and perceived stress/hassles in college students. *Stress and Health: Journal of the International Society for the Investigation of Stress*, 22(3), 179-188.
- Pavlova, I., Rogowska, A.M. & Zhang, S.X. (2024). Mental Health and well-being During the COVID-19 Pandemic and After the Russian Invasion of Ukraine. *J Community Health* 49, 173–182. <https://doi.org/10.1007/s10900-023-01273-x>
- Petrachkov, O., Yarmak, O., Shostak, R. et al. (2023). The effect of stress factors on cognitive and management functions of cadets of higher military educational institutions. *Journal of Physical Education and Sport*, 23, 162-169, <https://doi:10.7752/jpes.2023.01020>



- Powell, L. D., Gill, D. L., Reifsteck, E. J., & Brown, P. K. (2022). A Physical Activity Program to Promote Mental Health. *Recreational Sports Journal*, 46(1), 31-41.
<https://doi.org/10.1177/15588661211047557>
- Serpa-Barrientos, A, Calvet, MLM, Acosta, AGD, Fernández, ACP, Rivas Díaz LH, Albites FMA, & Saintila J. (2023). The relationship between positive and negative stress and posttraumatic growth in university students: the mediating role of resilience. *BMC Psychol.* 11(1):348.
<https://doi:10.1186/s40359-023-01400-2> .
- Steinacker, J.M., Mechelen, W.V., Bloch, W., et al. (2023). Global Alliance for the Promotion of Physical Activity: the Hamburg Declaration. *BMJ Open Sport & Exercise Medicine.* 9:e001626.
<https://doi.org/10.1136/bmjsem-2023-00162>

Published: 30.09.2024