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Modelling the Effectiveness of Recreational Physical Activities Focused on Improving Stress Tolerance in University Students During Wartime

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Abstract

Objectives. The present study aimed to evaluate the effectiveness of various health-enhancing recreational physical activity (PA) programs in the prevention of stress-related states in students during wartime.

Materials and methods. The study involved 125 university students, and used questionnaires comprising blocks of questions designed to ascertain psychophysiological indicators (activity, mood, sleep, appetite, performance, and well-being) with the 5-point Likert scale; stress level by Shcherbatykh; anxiety scores using the Spielberg-Hanin Inventory; and the risk of PTSD using the Mississippi Scale. To analyze the impact of different types of PA on stress-related states, logistic regression models were built. Additionally, GLZ models were used. The statistical significance of the models was assessed using the Wald test.

Results. The analysis indicated that adventure tourism is a statistically significant predictor ($p < 0.05$) of stress reduction, a decrease in heavy thoughts, and mood improvement. Mental fitness was found to be the most effective means for restoring mental balance. The models for predicting an increase in stress tolerance revealed dependencies on the type and amount of PA. This study contributes to the extant scientific knowledge base in the field of health-enhancing recreational physical activity aimed at preventing stress-related states. The proposed approach to the use of GLZ-models in the study of students' stress tolerance opens up new opportunities for analyzing the complex relationships between types of PA and psycho-emotional states.

Conclusions. The modelling results obtained allow for precise predictions regarding the effectiveness of different types of PA in the prevention of stress-related states among university students. The developed models can be used to generate individualized recommendations for physical activity, taking into account the unique needs, stress levels, and psycho-emotional state of students.

Keywords: students, adventure tourism, mental fitness, team sports, prevention, stress-related state, modelling, effect.

Introduction

Today's Ukrainian university students are exposed to military stressors for a long time (Andrieieva et al, 2023). They experience a significant psychological stress as a result of constant anxiety, fear for their lives and health, instability, and economic disruption caused by military operations (Byshevets et al, 2023; Rybalko et al, 2024). These factors lead to widespread stress-related states among students, such as stress, anxiety, and the risk of developing post-traumatic stress disorder (PTSD) (Petrachkov et al, 2023).

Currently, there is a significant body of research that supports the effectiveness of physical activity (PA) in preventing stress-related states among university students (Ai et al, 2021; Bramwell et al, 2023; Gerber et al, 2014).

However, there is currently limited information on the effectiveness of PA in preventing stress-related states in university students during wartime (Byshevets et al, 2023; Skaliy et al, 2024).

Researchers consider this category of students to be highly susceptible to stress (Fuente et al, 2018; Byshevets et al, 2023; Rybalko et al, 2024). Transitioning to independent living, adjusting to a new team and the demands of an educational institution, building relationships with classmates and teachers, increased academic workload, tests, exams, project work, and financial problems can all cause increased stress. Therefore, researchers are interested in determining which types of PA are most beneficial in preventing stress-related states in university students. Among the most effective types of PA, researchers mention mental fitness (Ahmed et al, 2021; Andrieieva et al, 2024) and physical exercise with music (Hanna, 1995), group exercise (Reed, Ones, 2006; Hakman et al, 2020; Mulyk et al, 2024), and adventure tourism (Kaplan, 1995; Holland et al, 2018; Ewert, Yoshino, 2011; Andrieieva et al, 2022, 2024; Mulyk et al, 2024). In addition, there is a growing body of research that provides strong evidence of a positive relationship between the effects of nature observation, outdoor walking, and recovery from stress (Van den Berg, 2010; Byshevets, Andrieieva, et al, 2024).

According to Holland et al (2018), recreational activities help improve mood in 67 % of cases, reduce stress in 64 %, increase self-esteem in 63 %, reduce depression in 62 %, improve concentration in 61 %, improve memory in 60 %, and improve cognitive function in 59 %. According to Ewert, Yoshino (2011), participation in short-term outdoor adventure programs prevents the development of stress in students, helps to increase their stress tolerance, and has a long-term effect that lasts for 2-3 years.

Researchers (Ahmed et al, 2021) demonstrated that three Pilates sessions per week for six weeks reduced academic stress in university students. Furthermore, Hanna (1995), who considers dance classes as physical exercises with a strong emotional coloration, emphasizes their exceptional effectiveness compared to other physical exercises. According to the author, dancing improves mood, reduces pain, distracts from problems, releases negative energy, create a feeling of pleasure and euphoria, and helps to overcome or mitigate the deleterious effects of stress factors. As for team sports, researchers have repeatedly emphasized the benefits of group classes, which are important because loneliness can lead to problematic behaviors in university that may include problem avoidance, wishful thinking, social isolation, and self-criticism (Fuente et al, 2018) In addition, Bramwell et al (2023) believe that outdoor group exercise can help prevent stress-related states in students.

The hypothesis of this study is that positive stress, which occurs during PA and is associated with a sense of challenge, goal achievement, and vitality, can serve as a compensatory or minimizing factor for the long-term negative stress experienced by students in the context of russian armed aggression against Ukraine. This positive stress can act as a preventive measure against stress-related states, such as stress, anxiety, and the risk of developing PTSD. Furthermore, it is hypothesized that higher loads and risk elements typical of such activities as adventure tourism can enhance this effect, especially under the impact of intense stressors. Positive experiences associated with overcoming difficulties, such as increased self-esteem, improved mood, and feelings of satisfaction, have been shown to mitigate symptoms of chronic stress and promote psycho-emotional health.

The issue of military stressors and their impact on university students, along with potential solutions that involve PA, is a pertinent one that warrants attention.

The objective of the study was to evaluate the effectiveness of various health-enhancing recreational physical activity programs in the prevention of stress-related states among students during wartime.

Materials and Methods

Participants

The sample included three groups of students who participated in different types of PA during the year (from October 2023 to September 2024). In total, the study involved 125 university students living and studying in Ukraine. The first group consisted of 46 students who participated in outdoor activities and took part in short-term outdoor adventure programs organized in Ukraine during the specified period. Of these students, 65.2 % were male and the remainder were female. The second group consists of 32 students who participated in team sports (volleyball, basketball). Of these, 78.1 % were male. The third group comprised 47 students who participated in mental fitness activities during the study, with 72.3 % of them being female.

The following inclusion criteria were applied: students aged 18 to 25 years old who were enrolled in higher education institutions in Ukraine; written voluntary consent to participate in the study; permanent residence in Ukraine throughout the study period; participation in regular classes in the relevant type of physical activity (adventure tourism, team sports, mental fitness) at least twice a week throughout the year; no serious medical contraindications to participate in the selected type of physical activity.

The exclusion criteria were as follows: the presence of chronic diseases or injuries that limit one's ability to engage in regular physical activity; failing to attend more than 20% of the planned training during the study; participation in other types of physical activity that could significantly affect the results of the study; refusal to participate in the study at any stage; failure to provide complete and accurate responses in questionnaires or other research documents. The implementation of these inclusion and exclusion criteria was intended to ensure the homogeneity of the sample and enhance the reliability of the results.

This study was conducted in accordance with the international ethical standards stipulated in the Declaration of Helsinki, as adopted by the World Medical Association. This included adherence to the principles of respect for human rights, ensuring the safety and well-being of participants, and transparency of the information collection process. The participants were provided with exhaustive information regarding the objectives of the study, the methods to be employed, the potential risks, and the potential benefits of participating. They also provided voluntary written consent to take part in the study. The personal data of the respondents was kept confidential and used exclusively for

research purposes. In the interest of protecting the privacy of the subjects, all data were anonymized. The organization of the study ensured that any discomfort or possible negative impact on the physical or mental health of the participants was minimized. The results are based exclusively on the data collected and do not contain any subjective interpretations.

Research Organization

The study utilized questionnaires comprising blocks of questions designed to ascertain 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 – 0.863); stress level was assessed by Shcherbatykh; anxiety scores were evaluated using the Spielberg-Hanin Inventory and the risk of PTSD using the Mississippi Scale. Improvements that could occur under the influence of PA classes and factors that can mitigate the impact of military stressors (adventure tourism / game sports / mental fitness) were measured with a categorical scale. The primary objective of these programs was the prevention of stress-related states during wartime. The following program parameters were common: frequency twice a week; duration 80 minutes; and medium intensity.

Statistical Analysis

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. In the absence of confirmation of these hypotheses, the measures of the central tendency and scatter of the studied indicators were presented using the median Me and the 1st and 3rd quartiles, which are less sensitive to outliers and deviations from a normal distribution. The data were presented in the form of Me (25%; 75%). To make a comparison between the characteristics of students engaged in different types of PA, a ranked analysis of variance was used, with the calculation of the Kruskal-Wallis H-criterion. Multiple comparisons were conducted, with -values being calculated, and the resulting data being evaluated against the critical value of the z-statistic, which is 1.96 for a significance level of 0.05.

The use of generalized linear and nonlinear models to predict improvements in students' well-being. To analyze the impact of different types of PA on stress-related states, logistic regression models were built to model the probability of improvement as a function of independent variables. GLZ models were used, which combine linear and nonlinear elements into a single structure, making the model flexible and suitable for a wide range of tasks (Shynkaruk, Byshevets, et al, 2025). This approach enables the analysis of both quantitative (e.g., stress, anxiety, PTSD risk) and qualitative (e.g., student groups, sex) data, incorporating both linear and nonlinear relationships between these variables. The utilization of these models enables the consideration of additional factors that may influence the dependent variable. It is noteworthy that the incorporation of a count variable within the model (in this instance, the number of stress-associated states) resulted in the statistical significance of certain variables that were previously deemed insignificant. This was made possible by reducing the standard errors and enhancing the model fit, which enabled the estimation of the effects of other variables with greater precision. Consequently, a multitude of variables have attained statistical significance at the 0.05 level, signifying a more accurate evaluation of their impact.

The Table 1 provides a detailed description of the variables utilized in the modeling process.

It is important to acknowledge that in earlier stages of the modeling process, sex was regarded as an independent categorical variable. However, in this case, statistical problems emerged in the models, which led to incorrect outcomes. Specifically, we found a lack of pivotal elements in the design matrix, which indicates a linear relationship between the predictors or multicollinearity. In addition, the distribution of the "sex" variable across the study groups was found to be imbalanced.

Given that the exclusion of the "sex" variable from the model did not result in a significant reduction in model quality, it was decided to exclude this variable from further analysis. This decision resulted in more stable and interpretable models.

The statistical significance of the models was then assessed using the Wald test. The quality of the models was evaluated using the following indicators:

Table 1. Description of the input data

Parameter / Type		Description	Value range	Encoding
Dependent	binary	Stress reduction	Occurred / did not occur	1/0
		Management of heavy thoughts	Occurred / did not occur	1/0
		Restoration of mental balance	Occurred / did not occur	1/0
		Mood improvement	Occurred / did not occur	1/0
		Improved stress tolerance	Occurred / did not occur	1/0
	continuous	Psychophysiological state, points	6 – 30	no encoding
Independent		Stress, points	0 – 66	no encoding
		Anxiety, points	20 – 60	no encoding
		Risk of PTSD, points	39 – 195	no encoding
		PA, points	0 – 49	no encoding
	categorical	Group	1, 2, 3	no encoding
Countable / ordinal		Number of stress-related states	0-4	no encoding

- Accuracy is an indicator that reflects the overall accuracy of classification, i.e. the extent to which the model correctly classifies each data sample.
- Recall is a metric that indicates the ability of a model to detect all relevant cases.
- Precision is a measure of specificity that shows what proportion of samples classified as positive by the model are actually positive. The maximum Precision value (0.88) was documented for the "Mood Improvement" model, indicating its high specificity.

The F1-score is a harmonic mean of Precision and Recall, which assess the overall balance of a model.

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

Results

In the course of the study, we examined the central tendency and the scatter of students' scores depending on the type of PA they were engaged in.

The adventure tourism group exhibited the lowest stress and PTSD risk scores. Furthermore, the highest levels of PA were observed among students participated in adventure tourism activities. The data obtained revealed that students' anxiety scores remained consistent with the lowest prevalence of stress-related states observed among those engaged in team sports (Table 2).

It was found that among the positive changes, the respondents most often indicated an improvement in mood: 80.4% of students participated in adventure tourism activities indicated this. With a lower frequency, students reported restoration of mental balance, where the highest results were observed among students engaged in choreography with elements of mental fitness (Fig. 1).

The data obtained was used to built logistic models that enabled the prediction of an improvement in students' state based on the studied parameters, including the type of PA.

$Stress = 24.47 + 3.84x_1 + 0.6x_2 + 0.05x_3 - 0.47x_4 + 0.51x_5 + 0.6x_6$

$Anxiety = 49.3 + 0.51x_1 - 0.2x_2 - 0.09x_3 - 0.88x_4 + 0.37x_5 - 0.17x_6$

$Risk\ of\ PTSD = 121.8 + 0.8x_1 - 0.55x_2 - 0.71x_3 - 6.72x_4 - 4.09x_5 + 2.7x_6$,

where x_1 is stress-related state; x_2 is psychophysiological state; x_3 is a physical activity level; x_4 is bad habits; x_5 is bad habits in group 1; x_6 is bad habits in group 2.

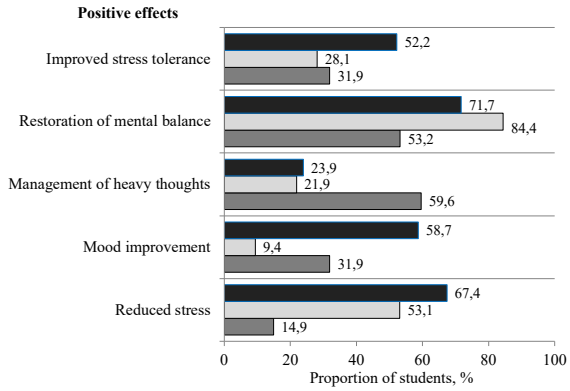


Fig. 1. Positive changes in students well-being under the influence of participation in different types of PA (n = 125). ■ – adventure tourism; □ – team sports; ▩ – choreography with mental fitness

Table 3 presents the estimates of the regression parameters, which are interpreted through the odds ratio. When the odds ratio exceeds 1, an increase in the value of the relevant predictor (e.g., anxiety) leads to an elevated probability of no improvement. Conversely, if the odds ratio is less than 1, an increase in the value of the predictor decreases the chances that the improvement will not occur. The reference group in this study comprised students who were engaged in choreography with elements of mental fitness.

The following conclusions can be drawn from the analysis of the coefficients of the "Stress reduction" model:

- an increase in the stress score by 1 point is associated with an increase in the probability of no stress reduction by almost 14 % (EXP(0.13)-1≈0.139);
- an increase in anxiety score by 1 point allows for the prediction of a decrease in the probability of stress reduction in the student by 24.6 % ((EXP(0.22)-1≈24.6 %);
- a decrease in the psychophysiological state reduces the probability of stress reduction by 22.9 % ((1-EXP(-0.26)-1)*100 %≈22.9);
- participation in adventure tourism activities was found to reduce the probability of no improvement by 87.5 % ((1-EXP(-2.08))*100 %≈87.5).

Table 2. The central tendency and the scatter of the studied parameters (n = 125)

Parameter	Group 1 (n = 46)			Group 2 (n = 32)			Group 3 (n = 47)		
	Me	25th percentile	75th percentile	Me	25th percentile	75th percentile	Me	25th percentile	75th percentile
Stress-related states, number	1.0*	0.0	2.0	0.0**	0.0	2.0	2.0	1.0	2.0
Psychophysiological state, points	23.0	19.0	26.0	22.5	19.0	24.0	22.0	18.0	25.0
Stress, points	14.0	9.0	22.0	15.0	6.5	23.3	18.0	13.0	30.0
Anxiety, points	44.0	41.0	46.0	42.0	40.0	46.0	43.0	41.0	45.0
Risk of PTSD, points	75.0*	69.0	89.0	81.5	69.5	97.0	83.0	75.0	100.0
PA, points	36.0	31.0	40.0	34.5	30.0	40.5	35.0	28.0	39.0

Notes: * – statistically significant differences between students of groups 1 and 3; ** – statistically significant differences between students of groups 2 and 3

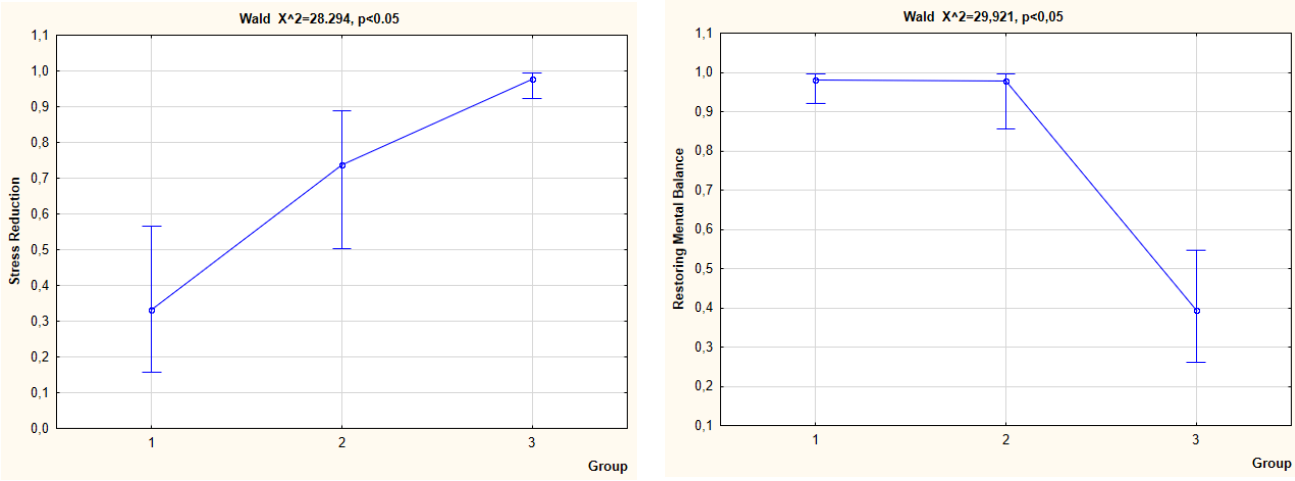
Table 3. Parameter estimates. Modeled probability that no improvement occurs (n = 125)

Effect		Distribution : BINOMIAL, Link function: LOGIT					
		Estimate	Standard Error	Wald Stat.	Lower CL 95, %	Upper CL 95, %	p
Stress reduction (Wald $\chi^2 = 28.29$, $p < 0.05$)	Intercept	-7.89	5.20	2.299	-18.09	2.31	0.1294
	Psychophysiological state, points	-0.26*	0.08	10.235	-0.43	-0.10	0.0014
	Stress	0.13*	0.04	10.475	0.05	0.22	0.0012
	Anxiety	0.22*	0.09	5.371	0.03	0.40	0.0205
	Risk of PTSD	-0.01	0.02	0.197	-0.04	0.03	0.6568
	PA, points	0.09	0.05	3.593	-0.00	0.18	0.0580
	Group (1)	-2.08*	0.47	19.568	-3.01	-1.16	<0.05
	Group (2)	-0.34	0.44	0.604	-1.19	0.52	0.4371
Management of heavy thoughts (Wald $\chi^2 = 10.03$, $p = 0.0066$)	Intercept	-14.15*	4.66	9.221	-23.28	-5.02	0.0024
	Psychophysiological state, points	-0.09	0.05	2.956	-0.20	0.01	0.0856
	Stress	-0.02	0.02	0.672	-0.06	0.03	0.4124
	Anxiety	0.15	0.08	3.698	-0.00	0.30	0.0545
	Risk of PTSD	0.12*	0.02	28.600	0.08	0.16	<0.05
	PA, points	0.05	0.04	1.494	-0.03	0.12	0.2215
	Group (1)	-1.47*	0.47	10.024	-2.39	-0.56	0.0015
	Group (2)	1.97*	0.75	6.863	0.50	3.45	0.0088
Restoration of mental balance (Wald $\chi^2 = 29.92$, $p < 0.05$)	Intercept	-2.34	4.00	0.343	-10.18	5.50	0.5583
	Psychophysiological state, points	-0.16*	0.07	5.574	-0.29	-0.03	0.0182
	Stress	0.20*	0.04	24.850	0.12	0.28	<0.05
	Anxiety	0.05	0.07	0.621	-0.08	0.18	0.4305
	Risk of PTSD	0.01	0.01	0.686	-0.02	0.04	0.4074
	PA, points	0.01	0.04	0.075	-0.07	0.09	0.7842
	Group (1)	1.52*	0.54	8.102	0.47	2.57	0.0044
	Group (2)	1.32*	0.65	4.128	0.05	2.60	0.0422
Improved mood (Wald $\chi^2 = 7.78$, $p = 0.0205$)	Intercept	13.60*	4.06	11.239	5.65	21.55	0.0008
	Psychophysiological state, points	0.01	0.05	0.068	-0.09	0.12	0.7946
	Stress	-0.00	0.03	0.028	-0.06	0.05	0.8676
	Anxiety	-0.05	0.06	0.743	-0.18	0.07	0.3887
	Risk of PTSD	0.01	0.02	0.737	-0.02	0.05	0.3905
	PA, points	-0.38*	0.06	34.638	-0.51	-0.26	<0.05
	Group (1)	-1.09*	0.42	6.609	-1.93	-0.26	0.0101
	Group (2)	0.38	0.44	0.760	-0.47	1.23	0.3833
Improved stress tolerance (Wald $\chi^2 = 3.68$, $p = 0.1587$)	Intercept	17.88*	5.01	12.736	8.06	27.70	0.0004
	Psychophysiological state, points	-0.32*	0.08	15.178	-0.49	-0.16	0.0001
	Stress	-0.05	0.03	3.534	-0.11	0.00	0.0601
	Anxiety	0.01	0.06	0.031	-0.11	0.14	0.8595
	Risk of PTSD	0.01	0.02	0.335	-0.02	0.04	0.5626
	PA, points	-0.29*	0.06	24.759	-0.41	-0.18	<0.05
	Group (1)	-0.71	0.39	3.342	-1.47	0.05	0.0675
	Group (2)	0.86	0.50	2.948	-0.12	1.84	0.0860

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

The findings suggest that the level of stress, anxiety, and psychophysiological state exerts a substantial influence on the probability of stress reduction in students. Furthermore, the most significant predictor is the type of PA. Specifically, participation in adventure tourism (Group 1) was found to have a substantial impact on the probability of stress reduction. The study also identified other statistically significant factors, including a negative impact of the levels of stress and anxiety on stress reduction, and a statistically significant negative effect ($p < 0.05$) of a decrease in psychophysiological state on stress reduction.

To illustrate, a hypothetical student with a psychophysiological state, stress, and anxiety scores of 25, 10, and 40 points, respectively, who engaged in adventure tourism



a b

Fig. 2. Probability of no positive effect: a – stress reduction; b – restoration of mental balance

would have an 82.1 % probability of not experiencing stress reduction. However, when engaging in other forms of PA, this probability increases to 97.3 %. Improving the psychophysiological state to 30 points results in a probability of no stress reduction of 55.5% when participating in adventure tourism and 90.9% when engaging in other types of PA.

The results of the model built using the Wald criterion (Wald $\chi^2 = 28.29$; $p < 0.05$) indicate that the type of PA has a statistically significant ($p < 0.05$) effect on stress reduction in students. Concurrently, other variables, such as psychophysiological state, stress, and anxiety, were considered as covariates, which allowed us to control their influence and isolate the individual effect of the type of PA. In a similar vein, we built and examined the models for the restoration of mental balance, mood improvement, and improved stress tolerance. Our findings indicated that adventure tourism is more effective in stress reduction, management of heavy thoughts, and mood improvement. On the other hand, choreography with elements of mental fitness is more effective in the restoration of mental balance in comparison to team sports (Fig. 2). The impact of PA on stress tolerance is not specific to its type, but rather contingent on its volume.

Therefore, it was demonstrated that participation in adventure tourism contributes to the stress reduction, the management of heavy thoughts, and mood improvement. Furthermore, choreography with elements of mental fitness is more effective in restoring mental balance.

The quality assessment of the models demonstrated that they possess high predictive capabilities. Specifically, the Accuracy score ranges from 0.83 for the "Restoration of balance" model to 0.91 for the "Stress Reduction" model. The "Mood Improvement" model demonstrated the maximum value of Recall (0.84), while the "Restoration of balance" model had the minimum values (0.72). The highest value of Precision (0.88) was recorded for the model "Mood Improvement", and the lowest (0.73) was observed for the model "Restoration of Balance". A similar trend was observed for the F1 score, with the maximum value (0.86) recorded for the "Mood improvement" model and the minimum value (0.73) for the "Restoration of Balance" model (Table 3).

The quality assessment of the models demonstrated their capacity to predict the improvement in various criteria. The most accurate models were those that predicted "Mood improvement" and "Stress reduction". These models exhibited

Table 4. Matrices of classification and quality assessment of the models

The built models	Class / Observed	Class Predicted		Indicators of model quality			
		0	1	Accuracy	Recall	Precision	F1 Score
Stress reduction	Observed 0	111	7	0.91	0.81	0.83	0.82
	Observed 1	8	35				
Management of heavy thoughts	Observed 0	94	13	0.85	0.80	0.77	0.78
	Observed 1	11	43				
Restoration of mental balance	Observed 0	98	13	0.83	0.72	0.73	0.73
	Observed 1	14	36				
Mood improvement	Observed 0	71	9	0.86	0.84	0.88	0.86
	Observed 1	13	68				
Improved stress tolerance	Observed 0	92	12	0.86	0.81	0.79	0.80
	Observed 1	11	46				

high values across all metrics evaluated, including Accuracy and F1-Score. The "Restoration of Balance" model exhibited slightly lower performance metrics; however, its predictive capability is also was high. The results obtained indicate the effectiveness of the built models for predicting the impact of different types of physical activity on psychological state.

Discussion

The findings on the effectiveness of various physical activities in alleviating stress-related states among students corroborate extant research conclusions on the substantial impact of physical activity on the mental well-being (Martín-Rodríguez et al 2024; Rybalko et al, 2024; Steinacker et al, 2023). Studies conducted by Biggs et al (2017) underscore the pivotal role of adaptive mechanisms, including physical activity, in the process of stress management. The studies (Reed & Ones, 2006; Gerber et al., 2014) emphasize that the type and context of PA are important for the effectiveness of its impact on the psycho-emotional state. Logistic models were built to predict the overcoming of stress-associated states in students based on data on the types of PA they are engaged in. A comparative analysis of these models reveals that the model designed to predict improved stress tolerance is the only one that does not incorporate the group variable. This observation indicates that the specific type of PA does not influence the extent of the improvement in stress tolerance among students.

Despite the fact that the students engaged in team sports activities demonstrated superior outcomes, elevated estimates of their risk of developing PTSD served to nullify the impact of other variables, thereby precluding them from exhibiting enhancements in the likelihood of stress reduction, management of heavy thoughts, restoration of mental balance, and mood improvement. The absence of a beneficial impact of team sports on stress tolerance may be ascribed to the elevated levels of competition and emotional distress that are hallmarks of these activities (Weinberg & Gould, 2019). As Weinberg and Gould (2019) indicated, elevated cortisol levels resulting from competitive sports activities have the potential to hinder the body's capacity for psychological recovery. Conversely, the superior outcomes observed in the mental fitness group may be attributable to the influence of hidden factors that were not directly reflected in the original data but play a pivotal role in the modeling.

The findings for the mental fitness and adventure tourism groups are consistent with research showing that less competitive activities, such as yoga or nature-based outdoor sports, contribute to lower levels of anxiety, depression, and general stress (Park et al., 2010; Berman et al., 2008). These activities often provide more opportunities for social support, self-reflection, and emotional recovery, which is supported by the findings of Biddle and Mutrie (2008).

The superior outcomes demonstrated by the adventure tourism group may be attributable not only to the inherent characteristics of the activity itself, but also to the influence of hidden factors. As Kaplan (1995) observes in his theory of restorative environments, exposure to nature exerts a beneficial influence on cognitive and emotional processes. The elements of adventure tourism, such as interaction with nature, social cohesion in the group, and a sense of achievement, have the potential to play a key role in the process of coping with stress.

While the models built were statistically significant, they indicated the need for improvement by expanding the sample to include different types of PA and more balanced consideration of sex-related characteristics. This recommendation aligns with the growing call for personalized approaches to physical activity as a means to manage stress (McEwen & Wingfield, 2003).

Furthermore, the unique challenges posed by wartime conditions necessitate the development of effective coping mechanisms to support students' mental well-being. The findings of this study underscore the necessity to integrate less competitive and more inclusive activities into PA programs aimed at the prevention of stress-related states. In particular, adventure tourism and mental fitness can serve as foundational elements of these programs. It is imperative to integrate less competitive activities into educational programs, particularly those that promote emotional engagement and social support. The development of adapted PA programs catering to diverse social and sex groups, with consideration for their unique needs in high-pressure circumstances, is also crucial. Further study of hidden factors, such as the impact of social cohesion, emotional support, and interaction with nature, is necessary to improve the effectiveness of prediction models. This study is among the first to examine the impact of different types of PA on the stress-related states among university students during wartime, thereby contributing to a more nuanced understanding of the mechanisms through which adventure tourism impacts the stress-related states in students.

Conclusions

This study demonstrated the effectiveness of PA interventions in mitigating stress-related states among university students during wartime. The study confirmed that the selected type of PA has a significant impact on the students' ability to overcome stress-related states. The findings emphasize the efficacy of less competitive activities, such as mental fitness and adventure tourism, in fostering a secure and nurturing environment conducive to emotional recovery. The lowest stress scores were found for the students of the Group 2, who participated in team sports, and the lowest risk of PTSD was observed in the students of the Group 1, who engaged in short-term outdoor adventure programs. Our findings indicate that adventure tourism is more effective in stress reduction, management of heavy thoughts, and mood improvement. Furthermore, the impact of mental fitness programs on the ability to manage heavy thoughts was more pronounced than that of team sports activities. The findings also reveal that adventure tourism exerts a more pronounced effect on students' perception of the military stressors. This phenomenon can be attributed to the substantial physical and mental loads associated with this type of activities, as well as the heightened emotional intensity experienced in comparison to other types of PA.

Limitations of the study. The use of self-reports can introduce a certain degree of subjectivity in the data, as participants may perceive and interpret their states differently.

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Conflict of Interest

The authors declare no conflict of interest.

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Моделювання ефективності рекреаційної фізичної активності, спрямованої на підвищення стресостійкості студентів університету в умовах війни

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 10 с., 3 табл., 2 рис., 38 джерел.

Мета дослідження – оцінити ефективність впливу різних програм оздоровчо-рекреаційної рухової активності у профілактиці стрес-асоційованих станів у студентів в умовах воєнного часу.

Матеріали та методи. У дослідженні взяли участь 125 здобувачів вищої освіти. Використано анкети, що містили блоки питань, спрямовані на визначення: психофізіологічних показників (активність, настрій, сон, апетит, працездатність, самопочуття; вимірювання – 5-бальна шкала Лайкерта від 1 (дуже погано) до 5 (дуже добре); альфа Кронбаха – 0,863); оцінки стресу, тривоги за опитувальником Спілберга-Ханіна; ризику ПТСР за Місісіпською шкалою. Для аналізу впливу різних видів рухової активності на стрес-асоційовані стани було побудовано логістичні регресійні моделі. Використано GLZ-моделі. Статистична значущість моделей перевірялася з допомогою критерію Вальда.

Результати. Аналіз показав, що пригодницький туризм є статистично значущим предиктором ($p<0,05$) для прогнозування зниження рівня стресу, зменшення нав'язливих думок і покращення настрою, ментальний фітнес виявився найбільш ефективним для відновлення психічного стану. Моделі прогнозування підвищення стресостійкості виявили залежності від виду та обсягу рухової активності. Дослідження доповнює сучасну наукову базу знань у сфері оздоровчо-рекреаційної рухової активності, спрямованої на профілактику стрес-асоційованих станів. Запропонований підхід до використання GLZ-моделей у дослідженні стресостійкості студентів відкриває нові можливості для аналізу складних залежностей між видами рухової активності та психоемоційними станами.

Висновки. Результати моделювання дозволяють з високою точністю прогнозувати ефективність різних видів рухової активності для профілактики стрес-асоційованих станів у здобувачів вищої освіти. Отримані моделі можуть бути використані для розробки персоналізованих рекомендацій щодо рухової активності для студентів з урахуванням їхніх індивідуальних потреб, рівня стресу та психоемоційного стану.

Ключові слова: студенти, пригодницький туризм, ментальний фітнес, ігрові види, профілактика, стрес-асоційований стан, моделювання, ефект.

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