

Application of mental fitness tools in the prevention of stress-associated conditions of female students of higher education establishments

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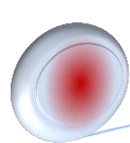
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Abstract.

Purpose: to check the effectiveness of the use of mental fitness tools for the prevention of stress-related conditions of female students of higher education establishments.

Material & methods: 56 female students, average age 19.5 ± 1.5 years, participated in the study. The main group (MG) included 34 participants who, for 6 months, practiced mental fitness twice a week for 80 minutes. 22 female students who formed the control group (CG) practiced the physical education program of a higher education institution twice a week for 80 minutes during the same period. The following research methods were used: analysis, synthesis, generalization, pedagogical experiment, survey, modelling, statistical analysis using correlation analysis, comparative analysis, effect assessment method, non-linear assessment methods, model quality assessment methods.

Results: the positive experience of implementing mental fitness programs into the practice of physical activity of higher education students is summarized. It was established that 71.4% of female students complain of mood swings, 60.7% – of anxiety, and 39.3% – of depressive states. After the study, 71.4% of female students indicated that their mood



improved, 67.9% reported an improvement in physical condition, and 57.1% focused on reducing stress levels. It has been proven that there are statistically significant ($p < 0.05$) correlations between the manifestations and indicators of stress-related conditions of students, the largest of which was recorded between the signs of PTSD and the indicators that determine stress-related conditions. Depending on the mental fitness classes, after the study there was a statistically significant ($p < 0.05$) reduction in PTSD symptoms, improvement in mood and well-being compared to CG students. After the study, the prevent post-traumatic stress disorders (PTSD) risk score for CG students was higher by 1.64 standard deviations compared to MG students. A statistically significant ($p < 0.05$) logistic binary model was developed, improved and scientifically substantiated, which, based on data on well-being, allows predicting whether a student is engaged in mental fitness. It has been proven that despite its lower predictive ability compared to other developed models, it has such advantages as statistically significant coefficients ($p < 0.05$), the ability to predict whether a student is engaged in mental fitness with 88.2% accuracy using only data on well-being, retention high prognostic ability with a significant simplification of the model. This shows that the developed model is the best choice for practical application.

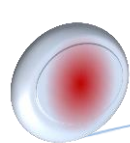
Conclusions: it is advisable to introduce mental fitness tools into the practice of health-recreational motor activity of female students in order to improve mood, work capacity and well-being, and, as a result, PTSD.

Key words: physical activity, mental fitness, student youth, stress, post-traumatic stress disorders, prevention, model

Introduction

Among the most effective measures for overcoming stress among student youth, scientists single out participation in health and recreational activities, meditation, breathing practices, and physical exercises (Andrieieva et al., 2023; Hakman et al., 2020). Among the scientific community, there is widespread opinion about the benefits of using mental fitness tools, such as yoga and Pilates (Shelikhova et al., 2021), to reduce the effects of adverse stressors in university students (Kashuba et al., 2020). Mental fitness tools are known for their ability to relieve stress, reduce anxiety, and promote relaxation. Numerous studies have confirmed that their use in order to overcome stress disorders in students gives a stable positive effect (Byshevets et al., 2023; Kosyanchuk, 2022; Nakonechna, 2017; Petrenko et al., 2020).

Analysis of data from the scientific literature showed the effect of yoga on reducing the secretion of cortisol, the main stress hormone (Limone et al, 2022; Sandhiya et al, 2022). Specialists are interested in the question of whether mental fitness tools, in particular yoga, contribute to reducing the effect of stressogenic factors in students of higher education. For example, C. L. Park et al. (2022) observed the dynamics of the health indicators of female students for 4 months and established

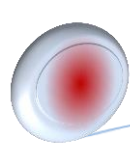


that practicing yoga and following a cognitive-behavioural stress management program improves certain indicators of physical and mental health. Yoga turned out to be especially effective, the practice of which statistically significantly ($p < 0.05$) reduced impulsivity and increased self-regulation - qualities that are important for overcoming stress in female students. The latest studies prove the therapeutic effect and confirm the expediency of yoga classes and the effectiveness of this practice for overcoming stress (Papp et al., 2023). On a sample of 79 students C.-L. Dai et al (2023) showed that practicing yoga for 15 weeks (5 min. – meditation, 35 min. – performance of asanas, 10 min. – relaxation) helped to improve physical condition, increase work capacity, form a positive attitude to physical exercises, decrease feelings of stress and anxiety, etc. At the same time, the author named the difficult technique of performing exercises, lack of self-confidence, reduced level of physical condition and competing interests as limiting factors preventing the growth of yoga popularity among students (Dai et al., 2023).

In addition to yoga classes, scientists report the successful implementation of the Pilates system in the practice of stress management among students. A. Noman et al. (2021) reported that doing Pilates three times a week for six weeks reduced their academic stress. The author indicates that the frequency of cases when students often or very often felt stress and tension during the last month decreased statistically significantly ($p=0.023$) (Noman et al., 2021). A comparative analysis of the effectiveness of yoga (breathing exercises, meditation, postures aimed at relaxation and stress reduction) and Pilates by M. Sandhiya et al. (2020) showed the effectiveness of using both mental practices to overcome academic stress (Sandhiya et al., 2020). The author notes that the means of Pilates are more accessible, from his point of view, the Pilates technique is more quickly learned by students, and therefore he recommends implementing Pilates in particular.

M. Andrabi et al (2023) testifies to the effectiveness of weekly yoga classes in groups of 50 minutes. A scientist has proven that in combination with individual yoga classes 3 times a week for 8 weeks, such classes can reduce stress and anxiety in students. Research by E. Akbaş (2018) proved that a six-week Pilates program had a positive effect on the health parameters of female students, including anthropometric characteristics, emotional state, fatigue and quality of life.

Currently, there is evidence regarding the effectiveness of mental practices for the prevention of stress-related conditions in students. Scientists inform about the positive experience of introducing yoga and Pilates programs in order to reduce the effects of adverse stressogenic factors in university students (Byshevets et al., 2023; Dai et al., 2023; Noman et al., 2021). Mental fitness classes accompanied by music, in addition to a pronounced health-improving effect, have a positive effect on the



psycho-emotional state of students. Classes with soothing music help to overcome stress and reduce its consequences. During the analysis of literary sources, we managed to find confirmation of the proposed hypothesis. So, J.L. Hanna et al (1995), considering dance classes, indicate their higher effectiveness in normalizing the psycho-emotional state compared to other physical exercises. According to the author, dancing improves mood, reduces pain, distracts from problems, releases negative energy, gives a sense of pleasure and euphoria, which helps to overcome or reduce the effects of harmful stress factors (Hanna et al, 1995).

The study and analysis of world practical experience indicates the expediency of using mental fitness tools in health and recreational physical activity programs for Ukrainian higher education students, who often suffer from the effects of stressful factors against the background of the military conflict (Hodes, 2022; Vorobyova, 2023).

Material and methods of research

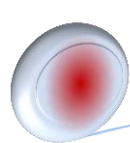
Participant

The research was conducted on the basis of higher education institutions (National University of Ukraine on Physical Education and Sport and Kyiv National Economic University named after Vadym Hetman). 56 female students aged 19.5 ± 1.5 years participated in the study. A preliminary analysis of the research contingent showed that 25% of them had a negative experience of being in the epicentre of hostilities. To the question "Have you experienced psychological problems in connection with the start of hostilities?" 28.6% of respondents indicated that they had such problems during the armed conflict. Another 39.3% chose the answer "Rather yes". And only 7.1% of respondents noted the absence of psychological problems. At the same time, 46.5% of higher education graduates had to use sedatives or sleeping pills from time to time with the beginning of hostilities on the territory of the country. And to the question "Have you developed (increased) bad habits since the beginning of the war?" 21.4 and 17.9 % answered "Yes" or "Rather yes". Thus, domestic students of higher education can be recognized as victims of martial law. Many of them are characterized by stress-related conditions and are potentially at risk of stress-related health disorders.

The research was carried out in compliance with the principles of the Declaration of Helsinki of the World Medical Association "Ethical principles of medical research with the participation of a person as an object of research." All participants signed an informed consent to participate in the study.

Research organization

The research participants were divided into two groups. The main group (MG) included 34 female students who, for 6 months, twice a week for 80 minutes.

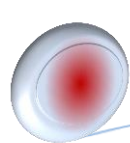


practiced according to the proposed program based on the means of Pilates and other means of mental fitness (meditative practices, breathing exercises). 22 female students made up the control group (CG), who practiced the physical education program of a higher education institution twice a week for 80 minutes during the 6 months. The program included the following parameters (Table 1).

Table 1 – Parameters of classes according to the program of mental fitness for female students of higher education establishments

Parameters	Characteristic (MG)	Characteristic (CG)
Duration of the program	6 months	6 months
The duration of the lesson	80 minutes	80 minutes
Multiplicity of classes per week	2 times a week	2 times a week
Means	Exercises of the Pilates system (The Hundred, The Roll Up, The Roll Over, The One Leg Circle, Rolling Back, The One Leg Stretch, The Double Leg Stretch, The Spine Stretch, Rocker With Open Legs, The Cork-Screw, The Saw, The Swan Dive, The One Leg Kick, The Double Kick, The Neck Pull, The Scissors, The Shoulder Bridge, The Bicycle, The Spine Twist, The Jack Knife, The Side Kick, The Teaser, The Hip Twist With Stretched Arms, Swimming, The Leg Pull – Front, The Leg Pull, The Side Kick Kneeling, The Side Band, The Boomerang, The Seal, The Crab, The Rocking, The Push Up, The balance control), meditative practices, breathing exercises	general physical training, means of athletics (walking, running), sports games (ping-pong), breathing exercises
Intensity	11-12 points on the Borg scale	11-12 points on the Borg scale

The following methodological recommendations are taken into account when building the training program: in order to transition to the main period of physical training, it is necessary to increase the external resistance during the first month, and then increase the number of repetitions. After increasing the physical load, the resistance can be increased again, and then the number of repetitions.



Statistical data analysis

In the course of the study, non-parametric methods of data analysis were used, since the data were either measured on an ordinal scale, or did not obey the normal distribution law, which was previously shown by the analysis of the assessment of the shape of the distribution according to the Shapiro-Wilk W-criterion.

Descriptive statistics. The main measures of central tendency are given by the median, and the spread by the 25th and 75th quartiles.

Correlation analysis. The Spearman correlation coefficient ρ was used to establish the interaction between stress-related conditions and indicators that cause it. The Chaddock scale was used to assess the closeness of the relationship between the studied indicators.

Comparative analysis between the indicators of CG and MG students was carried out using the Mann-Whitney U-test. Additionally, a Z-score is provided, which shows how far a particular observation deviates from the sample mean, measured in standard deviations.

Effect evaluation method. To estimate the size of the effect between MG and CG, we used the standardized difference of the SMD medians, which we calculated using the formula:

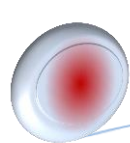
$$\text{SMD} = \frac{Me_1 - Me_2}{\sqrt{(n_1 - 1) \cdot s_1 + (n_2 - 1) \cdot s_2}} \cdot \sqrt{n_1 + n_2 - 2} \quad (1)$$

where Me_1, Me_2 – median indicators of female students by MG and CG; n_1, n_2 – volume of groups; s_1, s_2 – standard deviation for groups.

Modelling using logistic regression. Logistic regression was used to build models that, on the basis of data on indicators characterizing stress-related states of female students, can predict whether they engage in mental fitness. The dependent variable in the logistic regression is a binary variable that describes whether the student is engaged in mental fitness (1) or not (0). The Quasi-Newton method of estimating the model parameters was used.

Using the χ^2 statistical test, the statistical hypothesis that all regression coefficients are equal to zero (that is, the model has no predictive ability) was tested. This test is used to test the statistical significance of the regression coefficients, that is, the probability that their values are different from zero by chance. If the p-level was lower than the chosen level of significance, taken as 0.05, we rejected the null hypothesis and considered the model to be statistically significant ($p < 0.05$).

The method of assessing the quality of models. To assess the quality of the built models, such statistical metrics of the model quality as mean square error (MSE) and



mean absolute error (MAE) were used, which were calculated according to the formulas (2,3):

$$\text{MSE} = \frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)^2 \quad (2)$$

$$\text{MAE} = \frac{1}{n} \sum_{i=1}^n |Y_i - \hat{Y}_i| \quad (3)$$

where Y_i – observed value, \hat{Y}_i – predicted value, n – sample size.

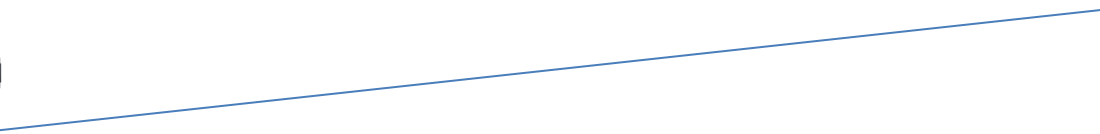
When interpreting the MSE, it was taken into account that a decrease in its value indicates a better ability of the model to predict values. At the same time, MAE indicates the average error of the model and demonstrates the extent of dispersion of the predicted relative to the observed values. At all stages of the statistical analysis, the value of 0.05 was taken as the level of statistical significance. If the p-level was lower than the specified level of significance, the null hypothesis was rejected and the obtained results were considered statistically significant ($p < 0.05$). We used the Statistica statistics program for data analysis (StatSoft).

Results of the study

Analysis of the research results showed that among the signs of stress-related conditions, the largest share of respondents complained about mood swings (71.4% in total) and anxiety (60.7% in total). More than a third of students indicated the presence of depressive states – 39.3% and aggressiveness – 32.1%. Only 17.9% of respondents did not show any stress-related conditions.

The study proves the positive impact of mental fitness tools on the physical and psycho-emotional state of higher education students: 71.4% of respondents indicated that their mood improved as a result of using these tools, another 67.9% testified to an improvement in physical condition, and 57.1% focused on reducing stress levels (Fig. 1).

It was established that there are statistically significant ($p < 0.05$) correlations between the manifestations and indicators of stress-related states of students. The greatest number of connections was recorded between the signs of PTSD and indicators that determine stress-related conditions.



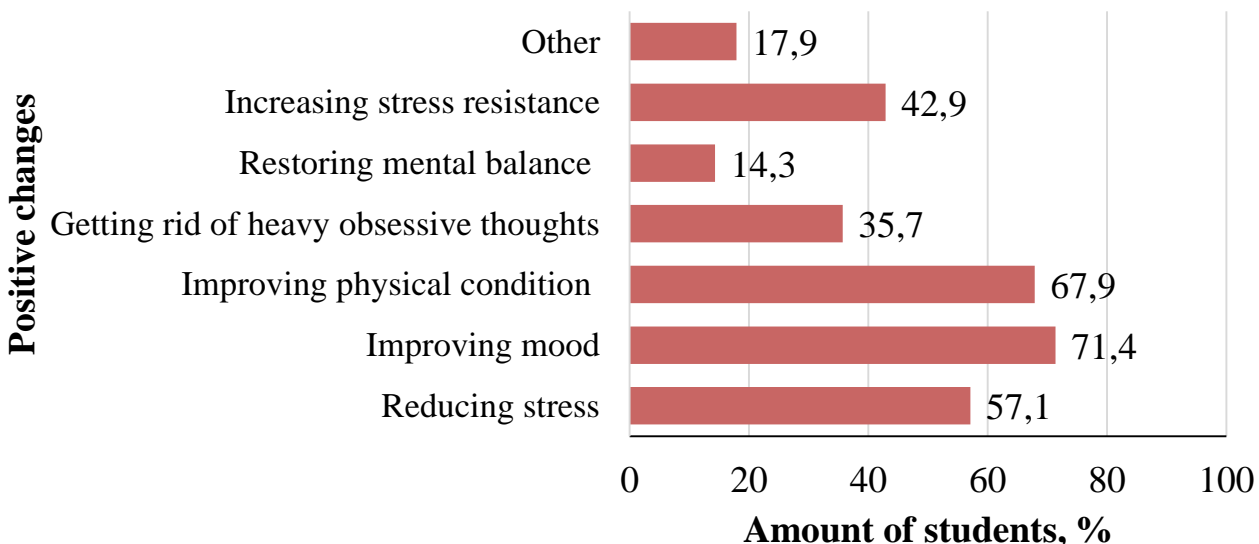
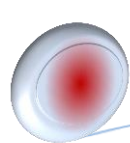
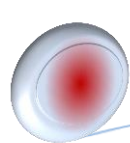


Figure 1 – Distribution of students by assessment of the impact of mental fitness tools, % (n=56)

We recorded a weak statistically significant inverse relationship between the PTSD score and activity ($\rho = -0.427$; $p < 0.05$) and moderate correlations with mood, work capacity and well-being ($-0.510 \leq \rho \leq 0.639$). It has been proven that as the risk of PTSD increases, students' activity, mood, work capacity and well-being decrease. The listed indicators are the most informative when determining such a stress-associated state of higher education students as a sign of PTSD (Table 2).

Table 2 – Correlation analysis of manifestations and indicators that determine stress-related conditions of female students (n=56)

Indexes	Spearman correlation ρ								
	1	2	3	4	5	6	7	8	9
1. Stress	1.000	-0.044	0.624	-0.237	-0.199	-0.539	-0.364	-0.282	-0.357
2. Anxiety	-0.044	1.000	0.084	0.377	0.025	0.294	0.359	0.334	0.301
3. Signs of PTSD	0.624	0.084	1.000	-0.427	-0.367	-0.639	-0.365	-0.510	-0.580
4. Activity	-0.237	0.377	-0.427	1.000	0.338	0.446	0.330	0.694	0.504
5. Sleep	-0.199	0.025	-0.367	0.338	1.000	0.662	0.639	0.483	0.430
6. Mood	-0.539	0.294	-0.639	0.446	0.662	1.000	0.690	0.682	0.806
7. Appetite	-0.364	0.359	-0.365	0.330	0.639	0.690	1.000	0.663	0.487
8. Working capacity	-0.282	0.334	-0.510	0.694	0.483	0.682	0.663	1.000	0.631
9. Well-being	-0.357	0.301	-0.580	0.504	0.430	0.806	0.487	0.631	1.000



The analysis of the manifestations and indicators that determine the stress-related conditions of female students, depending on the mental fitness classes, showed that after the study, there was a statistically significant ($p < 0.05$) decrease in the symptoms of PTSD compared to CG students. This result is primarily due to their statistically significant ($p < 0.05$) better mood and, most importantly, well-being compared to female students of CG (Table 3).

Table 3 – Analysis of manifestations and indicators that determine stress-related conditions of female students, depending on mental fitness classes (n = 56)

Indexes	Main measures of central tendency and dispersion						Statistical indicators of comparative analysis according to Mann-Whitney		
	CG (n=22)			MG (n=34)			U	Z	p
	Me	25 %	75 %	Me	25 %	75 %			
1. Stress	33.5	17.5	39.5	18.3	12.0	33.0	212.0	2.709	0.0067
2. Anxiety	44.0	42.0	48.0	46.0	44.0	48.0	328.0	-0.763	0.4453
3. Signs of PTSD	99.0	81.0	106.0	79.0	75.0	90.0	178.0	3.280	0.0010
4. Activity	2.0	2.0	4.0	4.0	3.0	5.0	240.0	-2.240	0.0251
5. Sleep	3.0	2.0	4.0	3.0	2.0	4.0	372.0	0.025	0.9799
6. Mood	3.0	2.0	3.0	4.0	3.0	4.0	204.0	-2.844	0.0045
7. Appetite	4.0	2.0	5.0	4.0	3.0	5.0	334.0	-0.663	0.5075
8. Working capacity	3.0	2.0	4.0	4.0	3.0	5.0	308.0	-1.099	0.2718
9. Well-being	2.0	2.0	3.0	4.0	3.0	5.0	170.0	-3.414	0.0006

Mental fitness tools had an effect on PTSD symptoms in female students: the PTSD risk score in CG students was 1.64 standard deviations higher compared to MG students. The same applies to stress: after the study, the intensity of stress among CG students exceeded the perceived stress among MG students by 1.26 standard deviations. And although statistical significance ($p > 0.05$) was not established between stress indicators in female students depending on the frequency of mental fitness classes, the standardized difference of the medians proves a significant practical effect of the applied means on their perceived stress.

As for anxiety, its manifestation among representatives of CG and OG turned out to be insignificant from both a statistical and a practical point of view (Fig. 2).

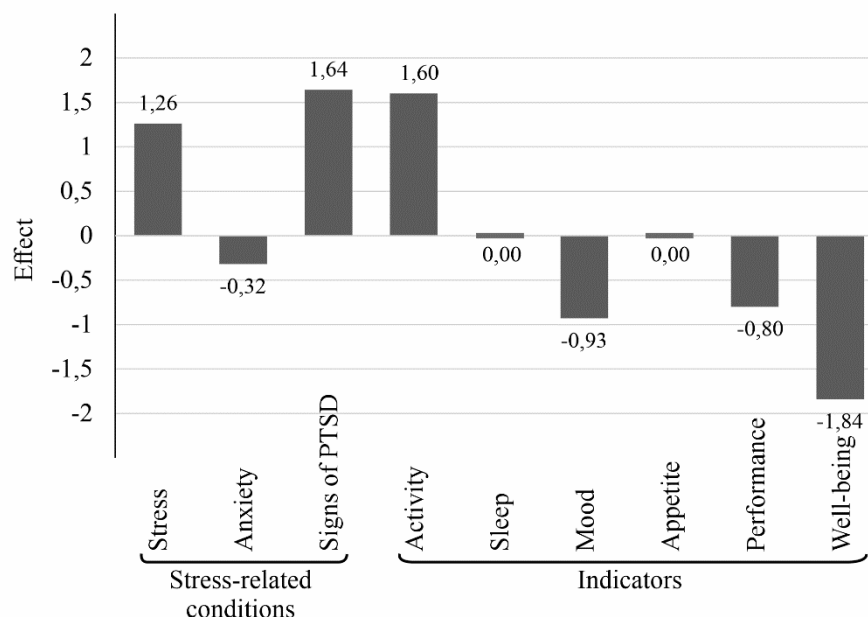
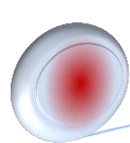


Figure 2 – Distribution of female students according to the assessment of the practical impact of mental fitness tools, % (n = 56)

Means of mental fitness had the greatest effect on the well-being of female students, where the difference between CG and MG was 1.84 standard deviations in favor of MG. In addition, after using the recommended means, the activity of MG students was 1.60 standard deviations higher than that of CG students. At the same time, the study proved a significant practical effect of mental fitness tools on the mood and work capacity of female students. However, no practical effect on the sleep and appetite of the study participants was recorded.

Modelling of the received empirical data regarding the influence of mental fitness on the indicators that characterize the stress-related states of female students showed that the best model that approximates them is Model 1. Based on all the investigated indicators, this model correctly predicts that the female student is engaged in 82.4% of cases mental fitness, and in 81.8% of cases - not doing it. However, for practical use, Model 5 is more appropriate, which takes into account only the well-being of female students. And although the predictive ability of this model is somewhat lower, compared to others (the model predicts that the student does not engage in mental fitness in 54.5% of cases), the model and its coefficients are statistically significant ($p < 0.05$) and according to the data on the student's well-being, it allows 88.2% of cases predict that a student is engaged in mental fitness. In addition, with a significant simplification of the proposed model, its prognostic ability decreased insignificantly (Table 4).

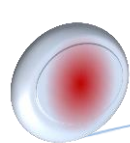


Table 4 – Modelling the influence of mental fitness on indicators of stress-related conditions of female students

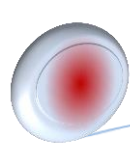
Model	Statistical metrics of model quality				
	χ^2	p	Precision (0/1), %	MSE	MAE
$y = -4,17 + 1,45X_1 + 1,75X_2 + 2,11X_3 + 0,68X_4 - 2,10X_5 + 0,99X_6$	32.640	<0.05	82.14 (82.3/81.8)	0.120	0.243
$y = -3,52 + 0,84X_1 + 0,68X_3 - 1,42X_5 + 1,23X_6$	23.131	0.0001	82.14 (88.2/72.7)	0.142	0.295
$y = -3,04 + 0,21X_1 + 0,004X_3 + 0,89X_6$	14.597	0.0022	78.57 (88.2/63.6)	0.175	0.355
$y = -3,04 + 0,21X_1 + 0,89X_6$	14.596	0.0007	78.57 (88.2/63.6)	0.175	0.355
$y = -2,70 + X_6$	14.025	0.0002	75.00 (88.2/54.5)	0.179	0.362

Note: $p = \frac{1}{1+e^{-y}}$ – logistic transformation; $X = \{1,2,3,4,5,6\}$ – indicators characterizing stress-related conditions (activity, sleep, mood, appetite, work capacity, well-being); p is the probability of the predicted event; e is the base of the natural logarithm ($e \approx 2.71$); accuracy - overall accuracy, 0 - predicting that the student is not engaged in, 1 - engaged in mental fitness

Therefore, mental fitness contributes to the improvement of well-being, which reduces the risk of developing PTSD. Thus, well-being acts as a mediator between mental fitness and PTSD. This suggests that improved well-being is a key mechanism through which mental fitness influences PTSD risk.

Discussion

Scientists are focused on the search for HRMA means that can reduce the manifestations of stress-related conditions in students of higher education and prevent stress-related health disorders in them (Andrieieva et al., 2022; Pavlova et al., 2023; Steinacker et al., 2023). Numerous testimonies prove their sustainable positive effect. The positive impact of mental fitness tools is emphasized in the studies of many scientists (Lim, Hyun, 2021). We have studied and summarized the experience of researchers in the implementation of mental fitness programs to overcome the stress of students of higher education. In the course of the study, we put forward the hypothesis that the implementation of programs based on mental fitness helps to reduce stress-related conditions of female students by improving the indicators that characterize them. To test the proposed hypothesis, we organized a pedagogical experiment in which 56 female students participated. 34 female students made up the MG, who fulfilled the proposed recommendations regarding the use of mental fitness tools, and the rest were made up by the CG. As a result of the study, we have



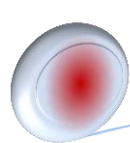
confirmed the effectiveness of using mental practices for the prevention of stress-related conditions in female students (Ai et al., 2021; Dönmez et al., 2023; Kim, McKenzie, 2014). Evidence of the maximum effectiveness of mental fitness tools on the symptoms of PTSD compared to other stress-related conditions became new data. At the same time, among the investigated indicators, the effect of mental practices is maximally extended to the activity, mood, work capacity and well-being of female students.

The developed prognostic models complement the knowledge about the influence of mental fitness on indicators that characterize stress-related conditions of female students. It has been proven that the model, which includes the well-being of female students, is the most acceptable. Although the predictive ability of this model is somewhat lower, it has the following advantages: statistically significant coefficients ($p < 0.05$), the ability to predict whether a student is engaged in mental fitness with 88.2% accuracy, using only data on well-being, maintaining a high predictive ability with a significant simplification of the model.

Thus, Model 5 is a better choice for practical applications, as it is easy to use and provides reasonably accurate predictions. In particular, if the student's well-being is rated at 5 points, then the probability that the calculations ($p = \frac{1}{1+e^{-(2,70+5)}} \approx 0,993$) show that the student is engaged in mental fitness in 99.3 % of cases. With an assessment of well-being of 4 points, the probability of classes decreases to 98.2 %, and with a decrease of well-being to 1 point - to 73.1 %, i.e. by 26.2 %. Obviously, mental fitness exercises have the greatest impact on the well-being of female students, the improvement of which is positively reflected in the manifestation of stress-related conditions in them. The conducted research allows us to state that it is advisable to introduce mental fitness tools into the practice of recreation of female students in order to increase their activity and improve mood, work capacity and well-being, and, as a result, prevent PTSD.

Conclusions

Ukrainian students against the background of the military conflict often experience stress-related conditions. Scientists prove the usefulness of using mental practices, such as yoga and Pilates, in order to reduce the effects of adverse stressogenic factors in university students. The global positive experience of using mental fitness tools to prevent stress-related conditions in students should be extended to Ukrainian students of higher education. The results of our research confirm that mental fitness tools can be successfully used for these purposes. The data we received show that primarily mental fitness contributes to improving the well-being of female students. In turn, this allows you to warn them of signs of PTSD.



The perspective of further research is to check the effectiveness of using other HRMA tools, in particular tools of extreme types of motor activity and adventure tourism, for the prevention of stress-related conditions in higher education students.

Author's contribution

Conceptualization, O.A. and N.B.; methodology, O.A., N.B. and V.K.; software, N.B.; check, O.A. and N.B.; formal analysis, O.A. and N.B.; investigation, O.A., N.B. L.P. and Yu.L.; resources, O.A., N.B., Yu.L. and L.P.; data curation, N.B.; writing – rough preparation, O.A. and N.B.; writing – review and editing, O.A., V.K. and L.P.; visualization, N.B.; supervision, O.A.; project administration, O.A. and V.K.

All authors have read and agreed with the published version of the manuscript.

Conflict of interest

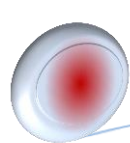
Authors state no conflict of interest.

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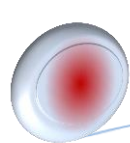
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