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Research article

Dynamics of anxiety of combatants during the course of hypobaric hypoxic training

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Abstract

Introduction. Combatants are most susceptible to neuropsychiatric disorders, including post-traumatic stress disorder (PTSD). Anxiety is one of the components of PTSD. Preserving the mental health of combatants and maintaining their professional and combat readiness is an important medical and social task which is now fulfilled through medical and psychological rehabilitation. Hypobaric hypoxic training (HHT) is one of the most effective non-drug methods of maintaining performance capability. The present article focuses on the dynamics of situational and personal anxiety of combatants in the process of medical and psychological rehabilitation using the HHT method.

Materials and Methods. The respondents included 17 combatants. The State-Trait Anxiety Inventory (Ch. D. Spielberger) was used. The course of HHT was conducted for ten consecutive days and included stepwise 'ascents' in a pressure chamber of reduced pressure from a height of 1500 to 3500 m. The level of situational anxiety was assessed before, during and after HHT and ten days after the completion of the course.

Results. The average level of situational (47 %) and trait anxiety (53 %) prevailed in the respondents. The high level of anxiety was also quite pronounced: 35 % for situational anxiety and 41 % for trait anxiety. During the course of HHT, a positive dynamics was observed — i. e., the levels of both situational and trait anxiety were reducing. This trend also continued ten days after the completion of the ten-day course of HHT.

Conclusions. The HHT training resulted in a statistically significant reduction of situational anxiety starting from the 5th session of HHT by 15 %, and after the 10th session, by 30 %. Situational anxiety decreased by 35 % by the tenth day after the completion of the course. Background indicators of trait anxiety upon completion of the ten-day course of HHT statistically significantly decreased by 6 %, and by the tenth day after completing the course, by 11 %.

Keywords: combatants, trait anxiety, situational anxiety, hypobaric hypoxic training, medical and psychological rehabilitation, post-traumatic stress disorder

Научная статья

Динамика тревожности комбатантов в процессе курса гипобарической гипоксической тренировки

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Аннотация

Введение. Участники боевых действий в наибольшей степени подвержены нервно-психическим расстройствам, в том числе и посттравматическому стрессовому расстройству. Одной из составляющих посттравматического стрессового расстройства (ПТСР) выступает тревожность. В настоящее время важной медико-социальной задачей является сохранение психического здоровья комбатантов, а также поддержание их профессиональной и боевой готовности. Для этих целей используется медико-психологическая реабилитация. В качестве одного из наиболее эффективных немедикаментозных методов поддержания работоспособности выступает гипобарическая гипоксическая тренировка (ГГТ).

Цель работы — исследование динамики ситуативной и личностной тревожности комбатантов в процессе медико-психологической реабилитации с использованием метода ГГТ.

Материалы и методы. В исследовании приняли участие 17 комбатантов. Применялась методика «Шкала оценки уровня реактивной и личностной тревожности» (автор — Ч. Д. Спилбергер; адаптация — Ю. Л. Ханин). Курс ГГТ проводился десять дней ежедневно и включал ступенчатые «подъемы» в барокамере пониженного давления с высоты 1500 м до 3500 м. Уровень ситуативной тревожности оценивался до, во время и после ГГТ, а также через 10 дней после завершения курса.

Результаты исследования. В группе обследуемых преобладали средний уровень ситуативной (47 %) и личностной тревожности (53 %). Однако достаточно выраженным был и высокий уровень тревожности: ситуативная 35 %, личностная 41 %. В ходе прохождения курса ГГТ наблюдалась положительная динамика, направленная на снижение уровня как ситуативной, так и личностной тревожности. Данная тенденция сохранялась и через 10 дней после завершения 10-дневного курса ГГТ.

Заключение. Ситуативная тревожность статистически значимо снижается, начиная с 5 сеанса ГГТ на 15 %, а после десятого сеанса на 30 %, через 10 дней после завершения курса данный показатель снижается на 35 %. Фоновые показатели личностной тревожности после прохождения 10-дневного курса ГГТ статистически значимо снижаются на 6 %, а через 10 дней после завершения курса на 11 %.

Ключевые слова: комбатанты, личностная тревожность, ситуативная тревожность, гипобарическая гипоксическая тренировка, медико-психологическая реабилитация, посттравматическое стрессовое расстройство

Introduction

According to the literature, neuropsychiatric disorders affect one in five combatants with no physical injures and every third wounded combatant (Spector 1998).

When it comes to the most common types of psychological disorders, 57 % of combatants experience fear, 50 % exhibit demonstrative behavior, 58.5 % display aggressiveness, and 75.5 % show suspicion (Spector 1998). Behavioral characteristics of combatants include family conflicts, emotional tension, anxiety, and increased irritability. They may also suffer from irrational episodes of fear and anxiety, a tendency towards pessimism and distrust, a sense of loss of meaning in life, and a lack of confidence in their abilities, etc.

A study conducted between 2006 and 2009 involving 305 combatants revealed that 54.4 % experienced adjustment disorders, while 11.4 % had short-term depressive reactions. Specifically, the findings included 10.1 % with prolonged depressive reactions, 11.4 % with mixed anxiety and depressive reactions, and 6.8 % with adjustment disorders accompanied by a variety of emotional disturbances. Additionally, 11.1 % were diagnosed with adjustment disorders predominantly featuring behavioral issues, 3.4 % with mixed emotional and behavioral disorders, and 45.6 % with PTSD. Within the PTSD group, 11.9 % exhibited clinical manifestations corresponding to anxiety, 10.9 % to the explosive type, 12.6 % to the somatoform type, and 10.3 % to the conversion type. Manifestations of PTSD included unmotivated anxiety, sleep disturbances, frequent mood swings, lethargy, hypersensitivity to everyday stimuli, suspiciousness, agoraphobia, and negativism (Ichitovkina et al. 2015).

A study conducted between 2019 and 2021 found that combatants with high levels of aggression prior to combat, as well as those who were wounded or captured in action, were most likely to develop PTSD symptoms (Zerach et al. 2023).

According to a study conducted in 2022, 30.6 % of 49 combatants (with 63 % first-time combatants and 37 % with prior combat experience) exhibited PTSD symptoms. Notably, first-time combatants demonstrated a higher level of neuropsychic tension compared to those with combat experience (Lubenskaya and Ryapolova 2023).

According to the 2023 data, the prevalence of PTSD in combatants accounts for 27.8 % (Shahmiri Barzoki et al. 2021). Additionally, the study revealed that combatant anxiety correlates with cognitive and physical issues after returning from a combat zone, while stress is associated with cognitive and social problems. Furthermore, PTSD and depression are more likely to occur in combatants with high anxiety and low social support (Pavlacic et al. 2023).

The relationship between PTSD and anxiety remains a significant issue. Post-traumatic stress disorder is defined as a mental disorder that develops following a severe psychotraumatic impact of a threatening or catastrophic nature, accompanied by extreme stress (Vasileva et al. 2022). The International Classification of Diseases 11th Revision (ICD-11) describes PTSD in Chapter 6 'Mental, Behavioural and Neurodevelopmental Disorders', block 6B4, which includes disorders specifically associated with stress (International Classification of Diseases 2022).

It is important to note that anxiety is regarded as a significant component of PTSD (Avedisova 2009; Bundalo 2009; Kaplan and Sadok 1994). N. L. Bundalo's study explores the relationship between situational (reactive) and trait anxiety in individuals with PTSD. The findings indicate that while the level of trait anxiety increases with the development of PTSD, the level of situational anxiety remains relatively stable (Bundalo 2009).

In a broad sense, anxiety is defined as 'an individual psychological trait marked by a high predisposition to feel anxiety in various life situations, including those that do not inherently provoke such feelings' (Petrovskij and Yaroshevskij 2011, 407). In Spielberger's research, trait anxiety is described as a stable characteristic that reflects an individual's predisposition to anxiety, indicating a tendency to perceive many situations as threatening.

Spielberger refers to situational (reactive) anxiety as 'tension, anxiety, and nervousness that arise as an emotional reaction to a stressful situation and can vary in intensity and duration' (Karelin 2013, 112).

Preserving the mental health of combatants is a crucial medical and social task. Some other items on this agenda include professional longevity and safety of individuals engaged in hazardous occupations, as well as forward-looking evaluation of their professional and combat capability (Blaginin and Annenkov, 2020).

In accordance with Order No. 60 'On Medical and Psychological Rehabilitation of Servicemen' issued 27 January 2017 by the Minister of Defense of the Russian Federation, combatants are provided with medical and psychological rehabilitation (MPR). MPR is defined as 'a set of medical, psychological, and general health-improving measures aimed at restoring military servicemen's performance capability' (Order of the Minister of Defense of the Russian Federation, 2017). Psychological rehabilitation goes along with medical and social rehabilitation.

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It primarily focuses on restoring the mental health of servicemen to enable them to effectively fulfill combat and service missions. A medical psychologist in the MPR department conducts psychological assessments of a combatant's condition and evaluates their motivation for the upcoming rehabilitation (Dolgikh et al. 2023). A study conducted in 2020 demonstrated a positive impact of digital technologies in the rehabilitation of combatants (Jones et al. 2020).

Hypobaric hypoxic training (HHT) was found to be an effective non-pharmacological method for enhancing the performance capacity of professionals engaged in hazardous occupations. It is no less effective as a rehabilitation tool after their exposure to unfavorable environmental conditions (Blaginin and Torchilo 2009; Blaginin et al. 2019).

HHT is widely used in rehabilitation of patients with neuroses, depressive and phobic forms of neurasthenia, borderline personality disorders, and mental disorders (Blaginin and Annenkov 2020).

In medical rehabilitation, HHT is employed to aid the recovery of patients with various diagnoses, including psychasthenia (Goranchuk et al. 2003), borderline personality disorders (Belevitin et al. 2010), arterial hypertension (Dzhankuldukova et al. 2010), breast cancer (Bratik 2013), mental disorders (Basovic 2011), and bronchial conditions such as asthma and chronic bronchitis (Nikolaeva et al. 2014). Additionally, HHT has been used for patients who developed bronchial asthma as a complication of COVID-19 pneumonia (Olenskaya et al. 2022) and patients suffering from anxiety and depressive disorders. HHT enhances cellular resistance and psychological resilience by fostering controlled responses to hypoxia (Burtscher et al. 2022).

Besides, there are studies examining the effects of moderate hypoxia on human cognitive abilities (Liu et al. 2021) and blood oxygen saturation during cardiopulmonary resuscitation (Suto et al. 2020).

However, despite the effectiveness of HHT in medical rehabilitation, it has never been used to enhance the psychological state of combatants.

The **reported study examines** the dynamics of situational and trait anxiety in combatants during medical and psychological rehabilitation using hypobaric hypoxic training.

Materials and methods

The study was conducted at the Department of Aviation and Space Medicine of the S. M. Kirov Military Medical Academy using a low-pressure (hypobaric) chamber (BKPD-5-1). It involved a total of seventeen male combatants, with an average age of 39.2 ± 9.2 years, who volunteered to join the study. All the respondents had a preliminary medical examination and received a medical clearance from an otolaryngologist, neurologist, and a general practitioner, confirming that there were no contraindications for doing an HHT course.

The HHT course included ten daily stepwise 'ascents' ranging from an altitude of 1,500 m to 3,500 m made at rest in a low-pressure chamber. The rate of ascent was 5–7 m/s, while the rate of descent was 3–5 m/s, with each exposure lasting for 30 minutes. Throughout the duration of the ascent, the participants' functional state was monitored using an objective medical control system installed in the chamber. The system measured heart rate, blood pressure, and oxygen saturation before the ascent, at 1, 15, and 30 minutes, as well as after the ascent (Berezhnov and Slepenkov 1995; Golofeevsky et al. 2005).

To assess anxiety, the State-Trait Anxiety Inventory (Ch. D. Spielberger; adapted by Y. L. Khanin) was used. Situational anxiety was measured before the 10-day HHT course, during the first HHT session at 1,500 m altitude, before and during the fifth session at 3,500 m altitude, during and after the tenth session at 3,500 m altitude, and ten days after the completion of the course.

Mathematical and statistical processing of the data was performed with STATISTICA 12.0 and Microsoft®Excel 2010. The normality of data distribution in the groups before and after the HHT course, along with the equality of general dispersion, allowed to use Student's t-test as a method of mathematical analysis for dependent samples. Additionally, the Wilcoxon T-test was employed to compare the data across related samples.

Results and discussion

Below are the results from the analysis of data obtained with the State-Trait Anxiety Inventory (see Figs. 1–2).

Before the HHT course, the group exhibited an average of 47 % situational anxiety. Additionally, prior to the course, 35 % of respondents had a pronounced situational anxiety, marked by tension, nervousness, and anxiety in specific situations. By the fifth HHT session, situational anxiety decreased, and was predominantly low at 59 %. This trend continued until the end of the HHT course, with 71 % recorded during the tenth session at an altitude of 3,500 m, and 59 % immediately after it. Within ten days following the completion of the HHT course, situational anxiety remained predominantly low at 76 %. This low level is associated

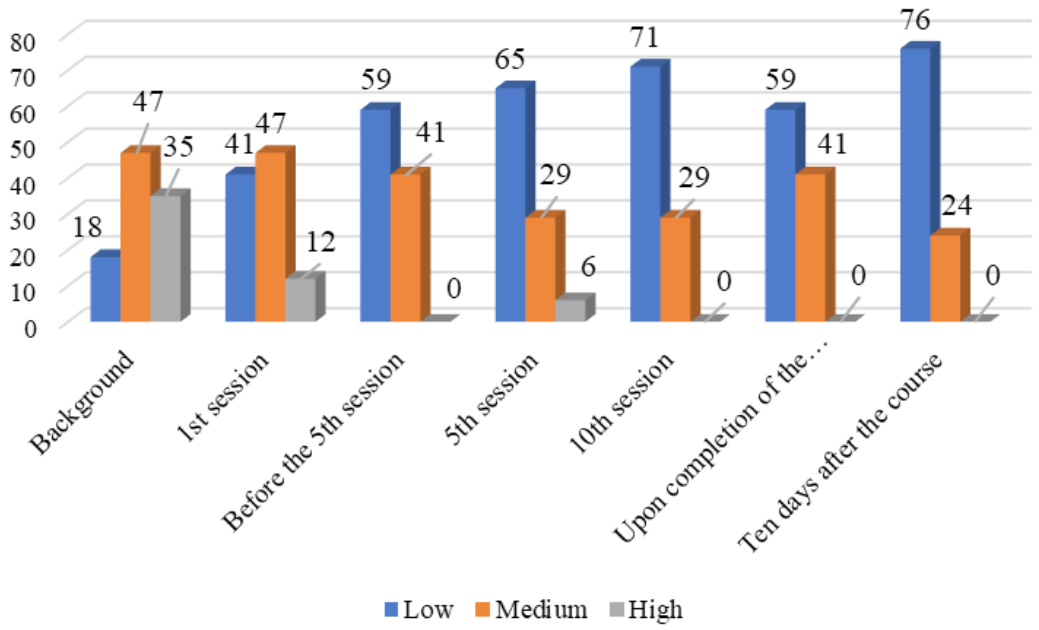

Fig. 1. Distribution of situational anxiety levels in combatants during the course of HHT (%)

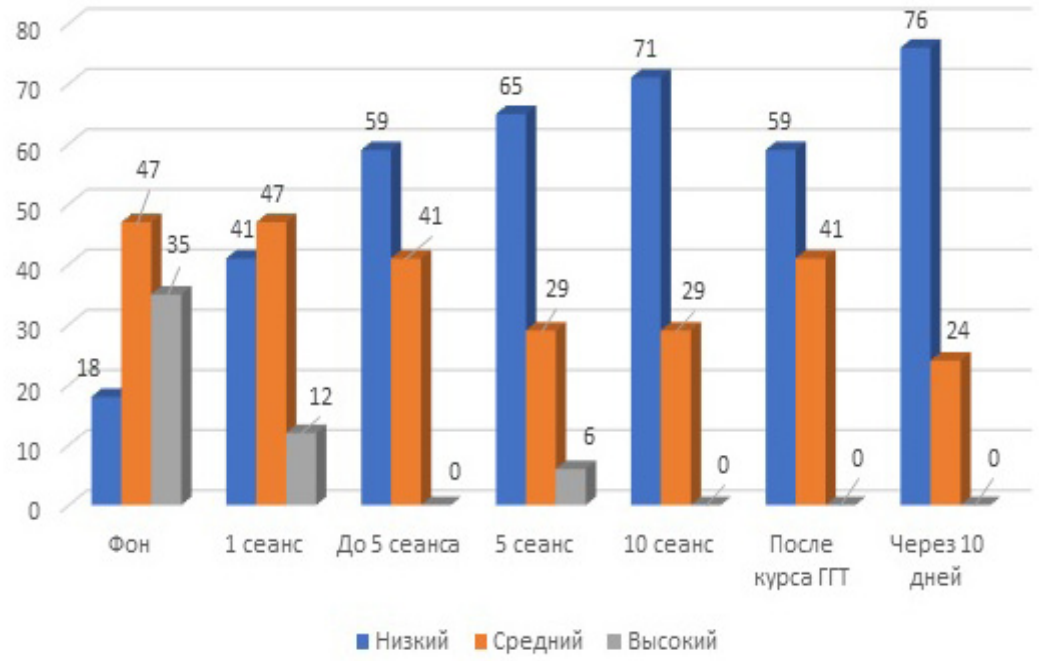

Рис. 1. Распределение уровней ситуативной тревожности в группе комбатантов в процессе курса ГГТ (%)

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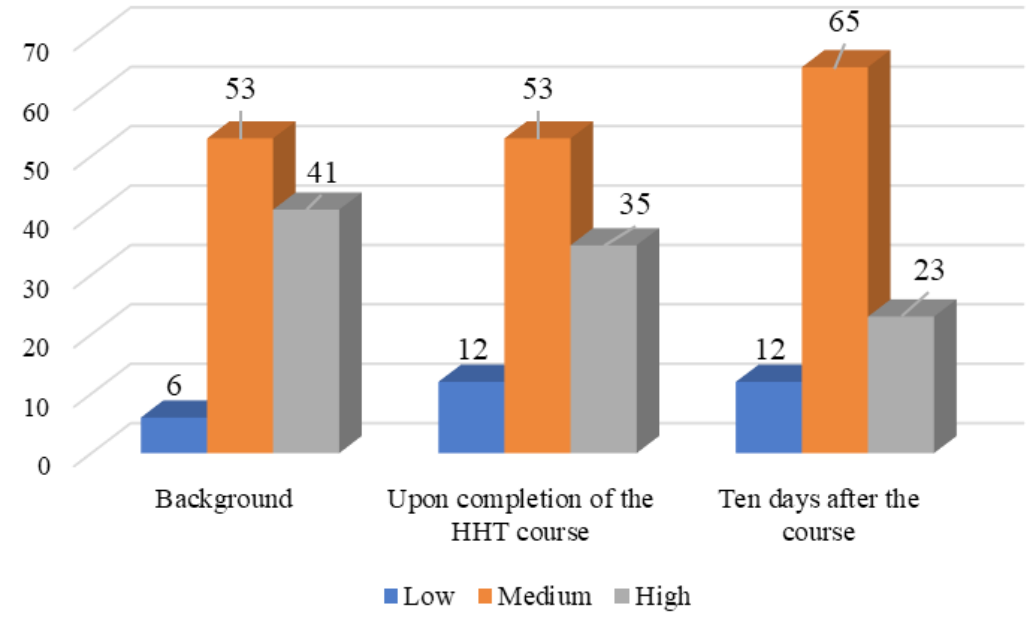

Fig. 2. Distribution of levels of trait anxiety in combatants during the course of HHT (%)

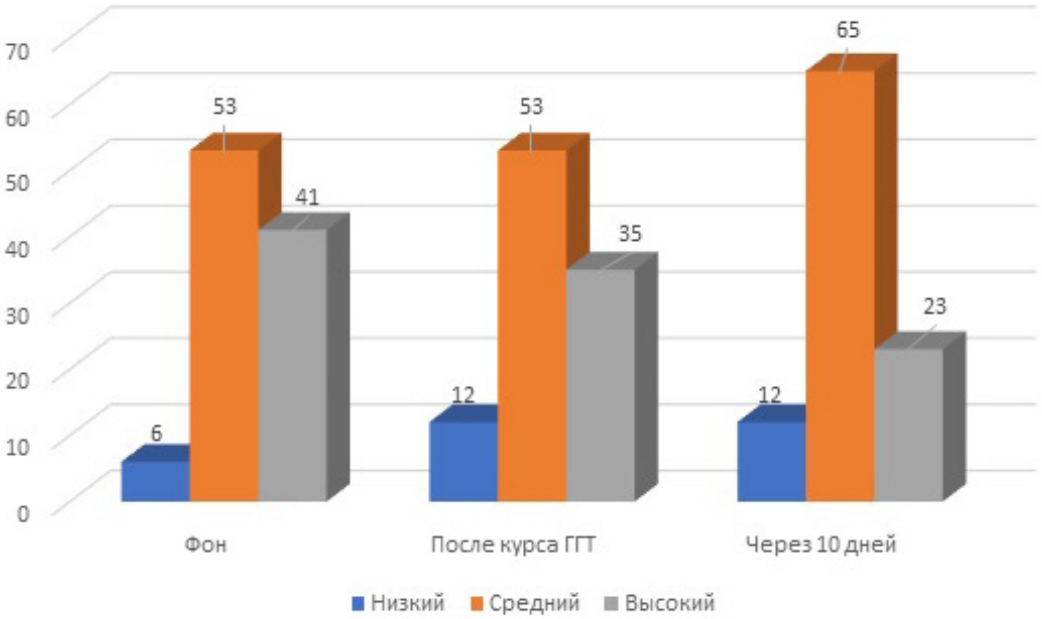

Рис. 2. Распределение уровней личностной тревожности
в группе комбатантов в процессе курса ГГТ (%)

with calmness, optimism, and self-confidence in specific situations.

Before the HHT course, the group exhibited medium and high trait anxiety at 53 % and 41 %, respectively. After completing the 10-day HHT course, trait anxiety decreased: high anxiety reduced to 35 %, medium to 53 %, and low anxiety stood at 12 %. Ten days after the completion of the HHT course, the downward trend continued with high trait anxiety falling to 23 %. At the same time, low anxiety remained at 12 %, while medium anxiety rose to 65 %. Respondents with an average trait anxiety typically experience a sense of comfort and emotional balance. They are able to maintain their effectiveness in situations they have adapted to. However, when faced with more complex challenges and difficulties, they tend to feel anxious, tense, and emotionally uncomfortable.

Student's t-test revealed that situational anxiety decreased significantly starting from the fifth HHT session. This trend continued throughout the entire HHT course and maintained for ten days after the completion of the 10-day training course (see Fig. 3).

At the beginning of the HHT course, one-third of the respondents exhibited acute tension, anxiety, high fatigue, and high general excitability. By the end of the course, however, the respondents became calmer and more self-confident in specific life situations.

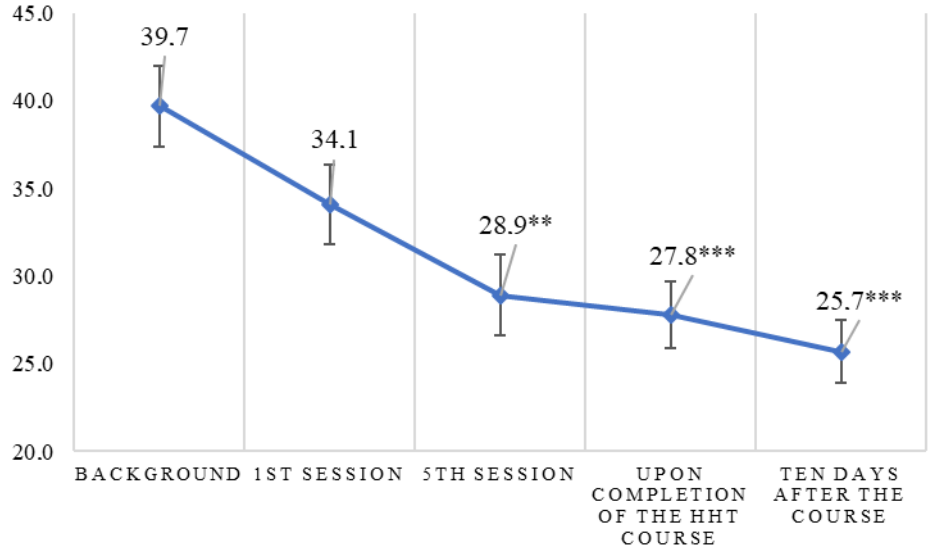

Fig. 3. Dynamics of situational anxiety during the course of HHT

Note:
*** — statistically significant differences* $t_{5th\ session} = 3.3\ (p \le 0.01)$;
**** — statistically significant differences* $t_{upon\ completion\ of\ the\ HHT\ course} = 4.0\ (p \le 0.001)$; $t_{ten\ days\ after\ the\ course} = 4.8\ (p \le 0.001)$.

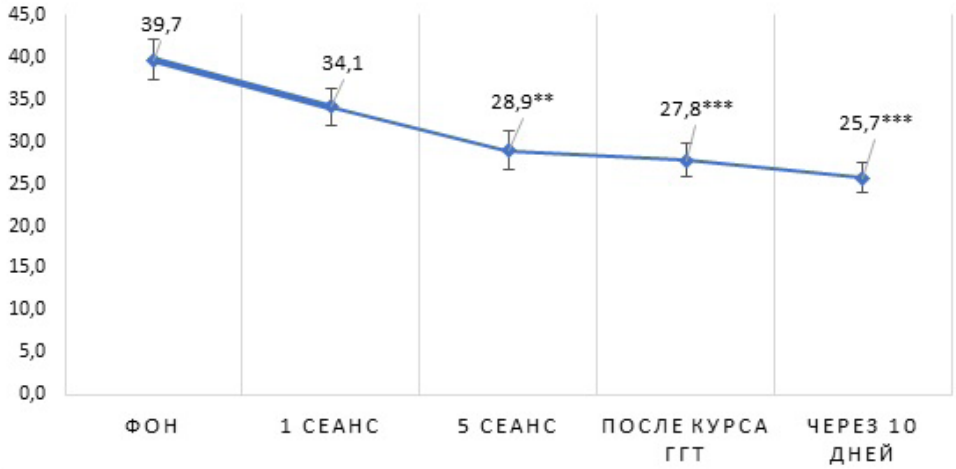

Рис. 3. Динамика ситуативной тревожности в процессе курса ГГТ

Примечание:
*** — статистически значимые различия* $t_{5\ сеанс} = 3{,}3\ (p \le 0{,}01)$.
**** — статистически значимые различия* $t_{после\ курса\ ГГТ} = 4{,}0\ (p \le 0{,}001)$; $t_{через\ 10\ дней} = 4{,}8\ (p \le 0{,}001)$.

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Wilcoxon T-test indicated that the baseline trait anxiety scores decreased significantly after the 10-day HHT course. Positive dynamics were also observed for 10 days after the completion of the training course (see Fig. 4).

Before the HHT course, the combatants exhibited relatively low self-confidence and self-reliance. They also showed increased sensitivity and impressionability. They perceived most life situations as threatening to their self-image and reputation. After completing the training course, the combatants became more decisive and independent, displaying reduced sensitivity and no longer perceiving most life situations as threatening.

According to the literature, a single 'ascent' in a low-pressure chamber serves as a hypoxic test and may increase both situational and trait anxiety (Bushov et al. 1993; Zavyalova and Posokhova 1980).

Importantly, clinically significant effects of hypoxic training typically become manifest after 10 to 20 sessions and can persist for one to three months (Glazachev 2013). Studies involving patients with psychasthenia (Goranchuk et al. 2003), borderline personality disorders (Belevetin et al. 2010), episodic tension headaches, chronic headaches, and migraines (Sharyakova 2012) have shown that 10 to 15 HHT sessions produced a notable decrease in both situational and trait anxiety. These findings align with the data obtained in the present study.

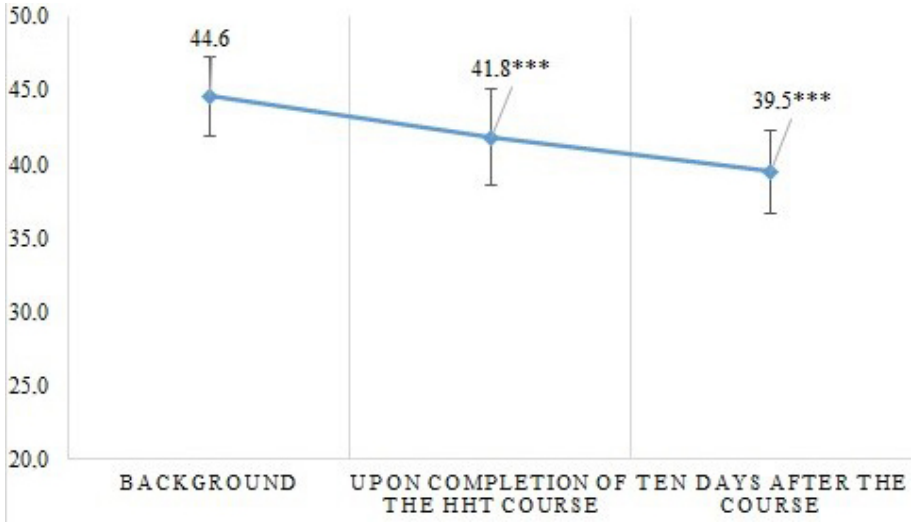

Fig. 4. Dynamics of trait anxiety during the course of HHT

*Note: *** — statistically significant differences* $t_{\text{upon completion of the HHT course}} = 38.5\ (p \le 0.001)$; $T_{\text{ten days after the course}} = 7.5\ (p \le 0.001)$.

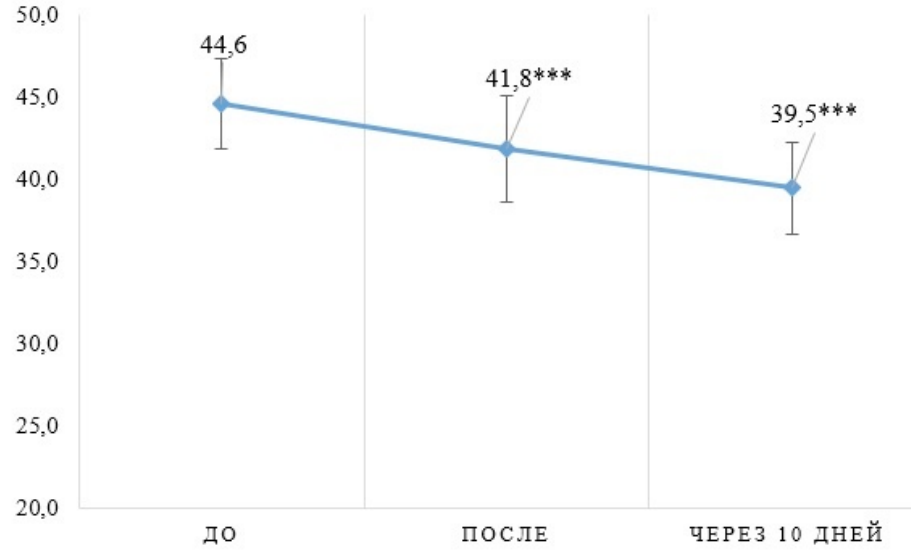

Рис. 4. Динамика личностной тревожности в процессе курса ГГТ

*Примечание: ***— статистически значимые различия* $T_{\text{после курса ГГТ}} = 38{,}5\ (p \le 0{,}001)$; $T_{\text{через 10 дней}} = 7{,}5\ (p \le 0{,}001)$.

Conclusions

Hypobaric hypoxic training used in medical and psychological rehabilitation of combatants reduces situational and trait anxiety. This positive effect remains for ten days after the completion of the training course.

Specifically, situational anxiety showed a statistically significant decrease starting from the fifth HHT session, dropping by 10.8 points (baseline: 39.7 ± 2.3; fifth session: 28.9 ± 2.3). After the tenth HHT session, it decreased by 11.9 points (baseline: 39.7 ± 2.3; tenth session: 27.8 ± 1.9). Ten days after the completion of the HHT course situational anxiety further decreased by 14 points (baseline: 39.7 ± 2.3; after 10 days: 25.7 ± 1.8).

Baseline trait anxiety scores decreased statistically significantly by 2.8 points after a 10-day HHT course (baseline: 44.6 ± 2.7; tenth session: 41.8 ± 3.2) and by 5.1 points ten days after the completion of the course (baseline: 39.7 ± 2.3; fifth session: 39.5 ± 2.8).

Thus, HHT helps to enhance the psychological state of combatants, including those exhibiting symptoms of PTSD. This, in turn, enhances the effectiveness of sessions with psychologists as part of medical and psychological rehabilitation of combatants.

The results of this study can find an application in non-pharmacological psychological rehabilitation of combatants.

In further studies, we plan to introduce interval hypoxic-hyperoxic training and compare its results with those obtained in this study.

Conflict of Interest

The authors declare that there is no conflict of interest, either existing or potential.

Конфликт интересов

Авторы заявляют об отсутствии потенциального или явного конфликта интересов.

Ethics Approval

The authors report that the study followed the ethical principles stipulated in for research involving humans and animals.

Соответствие принципам этики

Авторы сообщают, что при проведении исследования соблюдены этические принципы, предусмотренные для исследований с участием людей и животных.

Author Contributions

A. A. Blaginin — management of the work on the article, research idea, writing and editing the text of the manuscript.

E. A. Dudina — text formatting, description of empirical data, preparing the reference list, translation.

Вклад авторов

А. А. Благинин — руководство работой над статьей, идея исследования, оформление и редакционная правка текста публикации.

Е. А. Дудина — формирование текста статьи, описание эмпирических данных, оформление списка литературы, перевод.

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