

Psychophysiological states of elite athletes after critical life events

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Abstract

Background and Study Aim Military conflicts are a stress factor that provokes negative changes in the mental state of people. But, how susceptible are athletes to post-traumatic disorders at the level of psychophysiological functions? The purpose is to study the psychophysiological state of the elite athletes after critical life events related to the war in Ukraine.

Material and Methods Twelve elite female fencers, aged 18-23 years and members of the National Team of Ukraine, were examined. Their mental condition was assessed using the Lüscher color test, neurodynamic functions were evaluated with an anticipation test, cognitive characteristics through a decision-making test, and levels of anxiety were also measured. The psychophysiological state of the fencers was studied both before and after six months of the Russian military aggression against Ukraine.

Results The results indicated changes in the mental state of fencers under military conditions. Six months after the onset of the war, elite fencers exhibited signs of mental stress and a decreased resistance to stress. According to the obtained results, during the war, athletes showed a predominance of excitation processes over inhibition processes. The study revealed a deterioration in performance on decision-making tests and a decreased ability to perceive visual information in fencers six months into the war. As a compensatory mechanism for the reduced ability to process visual stimuli under conditions of information overload, a decrease in impulsivity among fencers was observed. Research on anxiety demonstrated that, over the six months of war compared to peacetime, trait anxiety among athletes significantly increased.

Conclusions Significant impacts of military actions on the psychophysiological state of elite athletes have been observed. This deterioration in mental state, along with decreases in neurodynamic and cognitive functions and an increase in personal anxiety levels, calls for the development and implementation of specialized psychological support programs. Such programs should aim to bolster athletes' resilience to stressful situations. The importance of accounting for psychophysiological aspects in the training of athletes within conflict zones is underscored, providing a basis for further research in this field.

Keywords: psychophysiological states, elite athletes, critical life events, fencers, war, Ukraine.

Introduction

In the modern world, numerous crisis points have emerged, characterized by a series of local military conflicts throughout the 20th century and into the first half of the 21st century. The repercussions of these conflicts are complex and often unpredictable, serving as significant stressors that provoke negative changes in individuals' mental states [1]. Among the severe impacts on those who have survived warfare is post-traumatic stress, a consequence of traumatic experiences that can elicit emotions such as fear, anxiety, and distress, potentially leading to avoidance of similar situations in the future [2]. For some individuals exposed to traumatic events, this emotional response can become overwhelming

and may evolve into post-traumatic stress disorder (PTSD) [3]. While most individuals diagnosed with PTSD eventually recover, a minority may develop chronic PTSD one year following the event [4].

One of the most significant crises of the 21st century is Russia's full-scale invasion of Ukraine on February 24, 2022. In terms of the scale of the events unfolding in Europe, this conflict can be compared to the Second World War.

Millions of refugees from the occupied territories have relocated to safer places, while millions more have left Ukraine in search of safety. Despite this, many individuals have chosen to remain in areas close to the front lines. Preliminary studies indicate that over 80% of Ukrainian citizens affected by the conflict develop post-traumatic stress disorder [5]. Recent research on mental disorders has established that mental harm is more likely to occur when traumatic events are experienced repeatedly [6].

Psychogenic shock, resulting from the suddenness of these events, leads to psychotrauma. This condition is further exacerbated by emotional conflict and the loss of future plans.

War constitutes a profound psychotraumatic event with significant effects on individuals' well-being and psychological state [7]. Post-traumatic stress disorder emerges as a primary health concern among those who have endured such experiences. PTSD represents a pathological reaction to traumatic events, including combat, natural disasters, or instances of physical or sexual assault [8].

Causes of PTSD in Ukraine include armed conflicts between states, explosions, arson, and other acts that terrorize the population; severe accidents at strategic facilities; direct experience or witnessing of physical or sexual abuse; shortages of water, food, electricity, and heating; and destruction of homes and cities [9]. Furthermore, the question arises: how susceptible are athletes to post-traumatic disorders at the psychophysiological level? Finding answers to this question is crucial for developing strategies to prevent post-traumatic syndrome among elite athletes.

Purpose: To investigate the psychophysiological state of elite athletes following critical life events associated with the war in Ukraine.

Materials and Methods

Participants

Twelve elite female fencers, aged 18-23 years and members of the National Team of Ukraine, were examined. Following the guidelines of the Biomedical Research Ethics Committees, all participants provided informed consent for the use of the research results for scientific purposes.

Research Design

Our approach was grounded in the understanding that psychophysiological states encompass various properties, including mental, neurodynamic, cognitive, and emotional characteristics. To assess mental properties, we utilized the modified Lüscher color test. Our previous research indicates that the Lüscher color test parameters accurately reflect the current mental state of athletes [10]. From the test results, we determined the following characteristics: mental performance, fatigue, anxiety, deviation from autogenic norms, eccentricity, concentricity, autonomic coefficient, heteronomy, and autonomy.

The neurodynamic functions are crucial for athletes in terms of perception and information processing, requiring a balanced excitation and inhibition within the nervous system for optimal performance. To assess this balance, an anticipation test was employed, yielding parameters such as accuracy, stability, arousal, and arousal tendency. Cognitive abilities were evaluated through a decision-making test, which examines an athlete's

problem-solving skills in response to environmental challenges [11, 12].

The athletes' anxiety levels and emotional stability were diagnosed using the Spielberger State-Trait Anxiety Inventory, assessing both situational and trait anxiety. To explore the impact of psychophysiological states following critical life events related to the Russian military aggression against Ukraine, studies were conducted on elite athletes before the onset of the conflict (December 2021) and six months afterwards (September 2022).

Statistical analysis

For the assessment of individual differences between the study groups, the Statistics 12 software was employed. Nonparametric statistical methods were utilized, focusing on the lower (25th percentile) and upper (75th percentile) quartiles.

Results

The analysis revealed significant changes in the mental state parameters of fencers during wartime, including deviations from autogenic norms, alterations in eccentricity and concentricity, as well as variations in the vegetative coefficient (Table 1). These findings demonstrate a marked impact of the military situation on the mental state of the fencers.

Before the onset of full-scale military aggression, fencers exhibited an average level of autogenic norms. Six months following the commencement of hostilities, a notable increase in the autogenic norm rates was observed. This elevation signifies heightened mental stress and a reduction in the ability to resist stress. Additionally, an increase in concentricity alongside a decrease in eccentricity among the athletes suggests a trend towards mental exhaustion and an inclination towards energy conservation.

A significant rise in the vegetative coefficient was recorded, indicative of a sympathetic tone predominance and neuropsychic stress under military conditions. Therefore, the military context has been identified as a catalyst for mental stress and diminished stress resilience, with an overwhelming sympathetic tone contributing to mental fatigue.

Table 1 demonstrates significant changes in the psychophysiological state of elite fencers during wartime, highlighted by an increase in the rates of deviation from autogenic norms, concentricity, and vegetative coefficient, alongside a decrease in eccentricity. These shifts signify heightened mental stress and reduced stress resilience, underscoring the impact of military conditions on the athletes' mental state.

A study of anticipation among fencers revealed significant differences in arousal values between the pre-war period and six months following the onset of war (Table 2). The findings suggest that during the war, arousal processes in athletes predominated

Table 1. Mental State Variables According to the Luscher Test in Elite Fencers (Median, Lower and Upper Quartiles)

Variables	Before War	Six Months After War
Psychosocial Capacity, conditional unit	11.32 (10.57; 12.28)	11.73 (10.53; 13.84)
Fatigue, conditional unit	2.45 (2.52; 4.74)	2.52 (1.56; 5.53)
Anxiety, conditional unit	1.64 (0.98; 3.52)	1.47 (0.96; 3.65)
Deviation from Autogenously Norms, conditional unit	11.47 (8.64; 13.53)	13.65* (12.14; 14.64)
Eccentricity, conditional unit	10.63 (8.56; 10.83)	8.01* (6.52; 10.73)
Concentricity, conditional unit	6.12 (4.72; 10.62)	8.68* (7.37; 11.63)
Vegetative Coefficient, conditional unit	12.50 (10.42; 15.68)	14.36* (12.79; 18.52)
Heteronomy, conditional unit	7.52 (6.87; 8.12)	7.50 (6.52; 10.76)
Autonomy, conditional unit	8.73 (8.83; 10.38)	8.73 (8.52; 9.78)

*Legend: *p ≤ .05, compared to the pre-war period.

Table 2. Results of Anticipation Test in Elite Fencers (Median, Lower and Upper Quartiles)

Variables	Before War	Six Months After War
Accuracy (Number of Errors)	2.73 (2.44; 3.10)	2.51 (2.14; 2.60)
Stability (%)	3.54 (3.31; 4.46)	3.47 (3.33; 3.82)
Arousal (Conditional Unit)	-0.16 (-0.36; -0.005)	-0.04* (-0.22; 0.001)
Arousal Trend (Conditional Unit)	-82.12 (-132.25; 5.61)	-87.94 (-162.90; 1.50)

*Legend: *p ≤ .05, compared to the pre-war period.

Table 3. Results of Decision-Making Test in Elite Fencers (Median, Lower and Upper Quartiles)

Variables	Before War	Six Months After War
Dynamism, conventional units	64.36 (62.51; 64.96)	59.89* (56.94; 62.42)
Capacity of visual analyzer, conventional units	1.49 (1.43; 1.68)	1.34* (1.33; 1.40)
Decision making time, ms	350.00 (350.00; 410.00)	410.00* (380.00; 440.00)
Impulsiveness, conventional units	-0.23 (-0.30; -0.21)	-0.44* (-0.51; -0.18)

Legend: *p ≤ .05, compared to the pre-war period

over inhibition processes.

Table 2 reveals that the anticipation ability among elite fencers exhibits significant changes during the wartime, particularly in terms of arousal values. A notable shift towards increased arousal and a dominance of arousal processes over inhibition is observed six months post-war, indicating a heightened state of readiness and potentially altered stress response mechanisms in athletes under military conditions.

A study on decision-making abilities reveals this trait as a marker for athletes' capacity to rapidly process information across various complexity levels (Table 3). Results indicate a decline in decision-making test variables among fencers six months post-war. Dynamism, reflecting the swift alternation of excitation and inhibition processes within the nervous system, significantly decreased, highlighting a decline in the development of new technical skills. Similarly, a deterioration in the capacity of the visual analyzer was observed, indicating a reduced ability to perceive visual information after six months of wartime conditions.

The significant deterioration in decision-making

abilities among elite fencers, as indicated in Table 3, suggests a slower processing of information and a decline in psychophysiological functions six months into the wartime period. Notably, an increase in decision-making time and a decrease in dynamism and visual analysis capacity point towards an adaptive response to heightened stress, potentially involving the mobilization of internal resources and the development of mechanisms for stress prevention.

Research into the anxiety levels among elite fencers indicates that situational anxiety has remained stable over six months of war, compared to peacetime conditions (Table 4). However, there has been a significant increase in trait anxiety among these athletes during the same period. These results suggest an elevated sense of danger, uncertainty, and anticipation of negative outcomes, processes that are accompanied by the depletion of internal resources, potentially culminating in mental exhaustion and disorders.

Situational anxiety reflects the immediate reaction to external threats and is expected to rise amidst military dangers [13,14]. However, the

Table 4. Results of Anxiety Test in Elite Fencers (Median, Lower and Upper Quartiles)

Variables	Before War	Six Months After War
Situational Anxiety, conventional units	20.53 (16.27; 22.63)	19.00 (15.00; 21.00)
Trait Anxiety, conventional units	34.26 (23.63; 42.26)	50.50* (40.00; 56.00)

Legend: * $p \leq .05$, compared to the pre-war period

stability of situational anxiety levels among elite fencers over the duration of the conflict suggests a high level of stress resilience within this group. In contrast, the increase in trait anxiety underscores the profound psychological impact prolonged exposure to war conditions has on athletes. Trait anxiety represents a more enduring predisposition to perceive situations as threatening.

Discussion

The contemporary global landscape is marked by numerous military conflicts involving various countries. The military aggression by Russia against Ukraine stands out due to its extensive scale, involving a significant number of individuals and resulting in considerable destruction and loss of life [15]. In the wake of these events, over ten million Ukrainian citizens have been compelled to flee the country in search of safety. The continued military actions induce a pervasive sense of fear for one's life, alongside anxiety and mental health disorders among those affected by the conflict [16].

Despite the ongoing conflict, Ukrainian athletes continue to participate in national and international competitions. However, the pervasive military situation in Ukraine challenges these athletes' true readiness for competition. This study aimed to examine the psychophysiological state of elite athletes in the aftermath of critical military events, specifically focusing on those associated with Russian military aggression against Ukraine. To achieve this, we assessed the psychophysiological state post-critical life events in a group of 12 elite fencers, analyzing key components such as mental, neurodynamic, cognitive, and emotional characteristics.

Our research identified significant alterations in the psychophysiological state of fencers exposed to a military environment. Notably, an elevation in the deviation from autogenic norms among fencers, observed six months into the military aggression, suggests an increased stress level and diminished stress resilience. These findings align with those of other scholars who have documented heightened levels of anxiety, depression, and stress among the Ukrainian population due to the ongoing conflict [17, 18].

The stress induced by the ongoing war has led to increased tension within the autonomic nervous system and mental fatigue among elite fencers, indicative of chronic war-related stress [19]. As a compensatory mechanism to avoid overstrain under

military conditions, a tendency to conserve mental energy has been observed in these athletes.

Neurodynamic assessments conducted six months after the onset of the war reveal a predominance of excitation processes in the nervous system among elite fencers, aligning with the identified chronic military stress. Furthermore, cognitive evaluations have uncovered a decline in the athletes' capabilities for visual perception and information processing.

Furthermore, six months into the war, a notable slowdown in the decision-making process was observed among fencers. This decrement in cognitive function is a recognized consequence of war-induced stress and post-traumatic disorders [13, 20]. Our findings corroborate that wartime conditions adversely affect the cognitive performance of elite athletes. This impact is particularly pronounced in the diminished capacity for developing new technical skills and processing visual information among elite fencers.

To counteract cognitive decline, elite fencers demonstrate reduced impulsivity during wartime, serving as a compensatory mechanism to conserve mental energy. This aligns with their subjective inclination to preserve cognitive resources. Comparable findings are supported by existing literature [21].

An examination of anxiety levels among elite fencers in a military setting showed no alterations in situational anxiety but revealed a noteworthy rise in trait anxiety. This finding underscores the notable stress resilience of elite fencers. The heightened trait anxiety observed in elite athletes is linked to the prevalence of post-traumatic disorders related to war [22, 23].

The results suggest an enhancement in the mental mechanisms of stress resilience among elite fencers, which serves to mitigate adverse outcomes and fosters the development of psychophysiological adaptive mechanisms in response to military conditions.

Conclusions

The findings revealed that six months into the war, elite fencers experienced heightened mental stress and diminished stress resilience. Additionally, in athletes, excitation processes overshadowed inhibition processes, leading to a decline in cognitive performance, as evidenced by poorer results in decision-making tests and reduced visual information processing abilities. Concurrently,

there was a notable increase in trait anxiety among the athletes.

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Conflict of interest

The authors declare that there is no conflict of interest.

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