

Medical Science of Ukraine

Медична наука України

2024. Т. 20, № 1

Національний медичний університет імені О.О. Богомольця

<https://doi.org/10.32345/2664-4738.1.2024>

Періодичність видання – 1 раз на квартал

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IMPACT OF ANAEROBIC EXERCISES ON EMOTIONAL STATUS

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Background. Physical activity can affect a person's mental and emotional well-being, and it can also be an effective way to reduce stress and anxiety. The importance of current topic is also exacerbated by modern lifestyles, which may include more and more stressors. Individual response to anaerobic exercise may vary depending on physical condition, duration and intensity of training, as well as special characteristics. Therefore, understanding how to maintain balance and maintain a healthy approach to sports remains extremely relevant for many people.

Aim: to analyze the impact of anaerobic exercises on the emotional state.

Material and methods. The review included 84 articles, which have been chosen using following keywords: «anaerobic exercise», «emotional state», «stress», «cortisol», «testosterone», in PubMed, Scopus and Web of Science databases. Analysis of scientific data has been conducted in order to collect the existed results of researches about the effect of anaerobic exercises on the emotional state.

Results. In the article we collected data about the relationship of anaerobic physical activity and its impact on emotional state. Present results of researches show that anaerobic physical activity can have a significant impact on emotional state. In particular, it's thought to promote the release of endorphins, improve mood and overall emotional well-being. Additionally, anaerobic exercise has been linked to reduced levels of stress hormones like cortisol. By engaging in intense physical activity, individuals can experience a reduction in feelings of stress and anxiety, as well as an increased ability to cope with difficult situations. Some studies even suggest that anaerobic activity may serve as an effective intervention in the treatment of mood disorders such as depression and anxiety and improves overall quality of life.

Conclusion. Anaerobic exercise activates sympathomedullary system, hypothalamic-pituitary-adrenal system and testosterone production resulting in positive physiological adaptation. Anaerobic exercise improves mood during and after exercise due to increased synaptic transmission of monoamines, which probably act on the same principle as antidepressant drugs. Physical activity stimulates the release of beta-endorphins which are responsible for feelings of calmness and improved mood after exercise.

Keywords: anaerobic exercise, emotional state, stress, cortisol, testosterone.

Background. Physical activity helps to improve physiological functions and motor qualities, increasing mental and physical performance. Moderate physical activity promotes the entire range of immune defenses. Anaerobic activities, such as weightlifting, sprinting, and high-intensity interval training, often trigger strong physiological responses through short bursts of intense effort.

Aim: to analyze the impact of anaerobic exercises on the emotional state.

MATERIALS AND METHODS

The review included 84 articles, which have been chosen using following keywords: «anaerobic exercise», «emotional state», «stress», «cortisol», «testosterone», in PubMed, Scopus and Web of Science databases. Analysis of scientific data has been conducted in order to collect the existed results of researches about the effect of anaerobic exercises on the emotional state.

RESULTS AND DISCUSSION

Physical activity has a various effects on mental functions, bringing them to a favorably active and stable state. Comprehensive clinical studies of athletes who exercise regularly show that systematic muscular activity enhances the body's mental, and emotional resilience over long periods of intense physical work. An active lifestyle and regular physical activity can increase the functional abilities of a person, which is explained by an increase in the reserve capabilities of the body. Activation of the physiological functions of the body during muscular activity can be considered as the mobilization of reserves. In this regard, a trained body has larger reserves and is able to use them more fully than an untrained one [1]. Studies have shown that regular physical activity significantly improves mood, self-esteem, overall well-being, and satisfaction with appearance [2]. There is a connection between physical activity and a person's emotional state. According to various authors, it is believed that psychological, emotional stress and physical activity are interrelated. However, most of the research focused on physical activity as a tool to mitigate distress [3]. Physical activity improves adaptation to stressors; people who exercise regularly are more socially adapted and resistant to stress than those who do not exercise. There is the evidence that some people consciously avoid regular physical activity, considering it unpleasant [4].

In the process of training, a person learns to better manage their emotions, as well as use self-regulation skills in various areas of life. Physical activity aimed at developing strength, speed, endurance, agility can increase the manifestations of mental stress, namely in professional sports. The athlete is favorably affected by low and medium physical activity using circular and uniform training methods. Since the harmonious development of all muscle groups leads to the dynamic manifestation of the processes of excitation and inhibition. Also, a decrease in aggressiveness occurs due to strength qualities and strength endurance [5].

The anaerobic energy system is represented by alactate and lactic components, which refers to the processes related to the breakdown of stored phosphagens, ATP and phosphocreatine, as well

as the anaerobic breakdown of carbohydrates to lactic acid through glycolysis. Anaerobic pathways are able to restore ATP at a high rate, however it is limited by the energy amount that can be released in a single intense exercise [6]. It is important to note that "anaerobic" metabolism is not a pathway that functions without oxygen, but rather it "does not use oxygen". Therefore, the "anaerobic" metabolism that converts adenosine triphosphate (ATP) and phosphocreatine should not be called "anaerobic", but rather "oxygen-independent" or "non-mitochondrial" [7]. Physical activity is consistently seen as a cost-effective way to improve fitness, prevent mental illness, and alleviate mood problems. Many authors discuss the effects of intensity, duration, and modality of exercise on mood changes. The results have shown that anaerobic exercise of moderate-intensity is associated with mood improvements. The relationship between exercise duration and mood changes is nonlinear. A 10–30-minute exercise regimen is sufficient to improve mood [8].

Despite the fact that regular physical activity in the form of both aerobic and anaerobic exercises has a positive effect on mood, at the moment there is no consensus on the most effective type of exercise. Authors such as K. Wang and J. Luo report that both anaerobic and aerobic exercise activities are effective [9]. Many psychological hypotheses have been used to explain the positive effects of physical activity on mental health, the main of them are: distraction, self-efficacy and social interaction. The distraction hypothesis suggests that distraction from a variety of stimuli leads to an improvement in mood during and after exercise, that is, during physical training, the body switches to more important functions at the moment, which leads to the displacement of psychological stress by physical stress [10]. The self-efficacy hypothesis suggests that because exercise can be thought of as challenging physical activities, the ability to engage in it regularly can lead to improved mood and self-confidence [11]. With regard to the social interaction hypothesis, the social relationships that are commonly found in group training and mutual support play a significant role in the impact of exercise on mental health, as the communication factor arises.

In addition, physiological hypotheses explain the effects of physical activity on mental health, the two most studied hypotheses being based on monoamines and endorphins. The first hypothesis is supported by the fact that physical activity increases the synaptic transmission of monoamines, which probably act on the same principle as antidepressant drugs [12]. The second hypothesis states that physical activity causes the release of endogenous opioids, mainly beta-endorphins [13]. It is likely that the inhibitory effect of these substances on the central nervous system is responsible for feelings of calmness and improved mood after exercise. Another suggestion is that there may be a possible link between increased irritability, nervousness and feelings of frustration reported by people who are actively involved in sports, but who noted the aforementioned emotions during the period of abandonment of training. This is due to the fact that they were in a state of endorphin withdrawal [14]. It is quite possible to assume that both of these hypotheses act together on our body [15].

Weight training involves anaerobic loading, also known as strength training, involves the voluntary activation of certain skeletal muscles against some form of external resistance. This external resistance is provided either by a free load or by various simulators [16]. Physical training, especially anaerobic exercise, affects the state of hormones of the hypothalamic-pituitary-gonadal axis, and this is especially true for high-intensity and physically demanding sports [17]. In response to physical and psychosocial stressors, not only the hypothalamic-pituitary-adrenal axis is activated, but also the sympathomedullary pathway.

The sympathomedullary pathway releases catecholamines that modulate the immediate fight-or-flight response, which optimizes bodily functions for behavioral stressor management. The hypothalamic-pituitary-adrenal axis activates a longer transient hormonal cascade, which ends with the release of glucocorticoids (cortisol) from the adrenal cortex [18]. Cortisol circulates in the peripheral blood, where it mobilizes energy, releasing glucose from storage sites. Cortisol plays a key role in the regulation of both physical and mental stress, regulating much of the catabolic adaptation to physical activity. The concentration of cortisol

in plasma depends on the intensity and duration of exercise, as well as physical fitness [19].

Activation of the hypothalamic-pituitary-adrenal system increases alertness for time, allowing for a response to severe physical or psychological events [20]. Excessive cortisol levels can have both positive and negative effects on the effectiveness of anaerobic exercise. Cortisol stimulates the breakdown of stored glycogen in the liver and muscles, increasing the availability of glucose for energy production. The increase in cortisol helps mobilize glucose and fatty acids in the blood, providing an immediate source of energy for the muscles during intense anaerobic exercise. It promotes the synthesis of enzymes essential for anaerobic energy systems, such as glycolysis, which allows the breakdown of glucose to produce ATP. This can increase productivity and allow to work at higher intensities for longer periods of time. Cortisol improves cognitive function, including alertness and focus. This can be beneficial during anaerobic exercise, as it requires mental focus and coordination to perform explosive movements and maintain proper form. Cortisol has anti-inflammatory properties that can help reduce exercise-induced inflammation and promote faster recovery. This can be especially helpful in preventing muscle soreness and fatigue, allowing people to exercise more frequently and achieve better results.

However, high levels of cortisol over a long period of time can result in the breakdown of muscle protein, hindering muscle growth and repair. Cortisol is known to suppress the immune system when it is constantly elevated. This can increase the risk of infections, disease, and slow down the recovery process, especially if people overtrain or mismanage exercise intensity and volume. Excessive cortisol levels can impair cognitive function, increase anxiety levels, and affect sleep patterns, ultimately affecting overall performance. Increased cortisol levels during intense anaerobic exercise can trigger a stress response in the body. This can lead to feelings of anxiety, restlessness, and even interfere with sleep patterns if people don't take enough time to recover and rest [21, 22].

As for testosterone, it improves athletic performance and plays an important role in muscle hypertrophy and muscle glycogen synthesis, increas-

es the activation and engagement of muscle fibers, resulting in improved strength and power production during anaerobic activities like weightlifting or sprinting. Testosterone helps reduce muscle damage and inflammation caused by exercise. It aids in the recovery process by stimulating the regeneration of damaged muscle fibers and connective tissues. This speeds up recovery and reduces muscle soreness. Testosterone stimulates the production of red blood cells in the bone marrow. It improves oxygen delivery to the muscles, increasing endurance and reducing fatigue levels during intense anaerobic exercise. And also, testosterone affects mental aspects such as motivation, aggression, and competitiveness. This can lead to more intense training and increased effort during anaerobic exercise [23]. Testosterone is the most powerful naturally secreted steroid androgen hormone. It is necessary for the development of secondary male sexual characteristics, as well as for muscle growth and neuromuscular adaptation [24]. At the muscular level, testosterone is known to have an anabolic effect through the following two mechanisms: stimulating amino acid uptake and protein synthesis and inhibiting protein degradation by counteracting cortisol signaling [25].

Age, overweight, poor diet, stress, sleep deprivation, and alcohol consumption are known factors that lead to decreased serum testosterone concentrations. Thus, maintaining physiological testosterone levels has significant health benefits. Numerous studies have shown that anaerobic exercise can cause drastic changes in serum testosterone concentrations [26]. Circulating testosterone levels have been shown to increase immediately after resistance training and return to baseline or even decrease beyond that level within 30 minutes of exercise [27]. The main factor determining the increase in plasma testosterone concentration is muscle mass. Numerous authors have evaluated hormonal changes when performing multi-joint movements of the lower body (e.g., squats) or weight-bearing exercises on a machine (e.g., leg presses) [28, 29]. Free-weight exercise caused an increase in plasma testosterone concentrations than weight training [30]. A potential explanation for this finding is that the squat requires balancing on two legs with active involvement of

stabilizing and core muscles, such as the abdominal and back muscles. Muscle activation studies have also shown that free weight exercises lead to greater muscle activation than machine exercises, likely by increasing overall muscle mass than similar weight-bearing exercises on a machine [31]. Another possible explanation for this hormonal change is the involvement of more muscle mass, which, in addition to resistance, may be required in order to cause significant drastic changes in plasma testosterone concentrations [32].

CONCLUSION

Our review study has shown a positive effect of anaerobic physical activity on the psycho-emotional state. Activation of the sympathomedullary system, hypothalamic-pituitary-adrenal system contribute to the positive physiological adaptation of athletes and is a consequence of the balance between anabolic and catabolic processes. Anaerobic exercise is a direct stimulant of testosterone production when a sufficient load on muscle mass is achieved or when moderate to higher exercise intensity is combined with greater muscle volume and shorter rest periods between sets. In order to prevent the negative effects of anaerobic physical activity on the emotional state, it is necessary to include proper warm-up and cool-down exercises before and after anaerobic activities, this can help regulate the body's response to physical stress and minimize the impact on the emotional state. Gradual warm-up exercises prepare the body for intense activity, while cooling down exercises allow the body to slowly return to a state of rest, reducing the likelihood of emotional distress. Maintaining a healthy diet and drinking patterns are essential for maintaining both physical and emotional well-being. Consuming a balanced diet provides the body with the necessary nutrients to maintain intense activity and promote emotional stability. Overtraining and not getting enough rest can lead to physical exhaustion, which can contribute to emotional imbalances. Including rest days in your workout schedule allows body and mind to recover, ensuring optimal emotional well-being during anaerobic exertion. It is also necessary to use mindfulness and stress

management techniques. Practicing mindfulness and stress management techniques, such as deep breathing, meditation, or yoga, can help reduce emotional stress during and after anaerobic physical activity. These techniques promote relaxation and help people stay present, allowing them to better manage their emotional state. Group workouts can not only increase motivation but also help individuals manage their emotional well-being by sharing experiences and creating a sense of camaraderie. Setting realistic goals and expectations for anaerobic physical activity can help minimize frustrations that can negatively impact emotional well-being. People should be aware of their limits and gradually increase the intensity and duration of their workouts to avoid burnout and maintain a positive emotional outlook. Overall, a holistic approach that combines physical and emotional well-being is needed to prevent the negative effects of anaerobic physical activity on emotional well-being. Implementing these strategies can help individuals maintain a positive emotional outlook during intense physical activity.

Conflict of interests. The authors of this manuscript claim that there is no conflict of interest during the research and writing of the manuscript.

Sources of funding. The execution of this study and the writing of the manuscript were accomplished without external funding.

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Article history:

Received: 02.01.2024

Revision requested: 05.01.2024

Revision received: 03.02.2024

Accepted: 25.03.2024

Published: 30.03.2024

ВПЛИВ АНАЕРОБНОГО ФІЗИЧНОГО НАВАНТАЖЕННЯ НА ЕМОЦІЙНИЙ СТАН

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Актуальність. Фізична активність може впливати на психічний та емоційний стан людини, а також може бути ефективним способом зменшення стресу та тривоги. Актуальність цієї проблеми також посилюється через сучасний спосіб життя, який може включати дедалі більше факторів стресу. Індивідуальна реакція на анаеробне навантаження може варіювати в залежності від фізичного стану, тривалості та інтенсивності тренувань, а також від особливих особливостей. Тому, розуміння, як зберегти баланс і дотримуватися здорового підходу до спорту, залишається надзвичайно актуальним для багатьох людей.

Ціль: проаналізувати вплив анаеробного фізичного навантаження на емоційний стан шляхом огляду існуючих даних медичних досліджень.

Матеріали та методи. Проведено огляд 84 статті, які були відібрані за такими ключовими словами: «анаеробні навантаження», «емоційний стан», «стрес», «кортизол», «тестостерон», у базах наукових медичних даних PubMed, Scopus та Web of Science. Проведено аналіз існуючих результатів досліджень про вплив анаеробного фізичного навантаження на емоційний стан людини.

Результати. У статті наведено дані про взаємозв'язок анаеробної фізичної активності та емоційний стан. Сучасні результати досліджень свідчать, що анаеробна фізична активність може мати значний вплив на емоційний стан. Зокрема, вважається, що анаеробна фізична активність сприяє вивільненню ендорфінів, покращенню настрою та загальному емоційному благополуччю. Крім того, анаеробні вправи пов'язані зі зниженням рівня гормонів стресу, таких як кортизол. Регулярні анаеробні навантаження можуть призводити до зниження почуття стресу та тривоги, а також підвищену здатність справлятися зі складними ситуаціями. Деякі дослідження показують, що анаеробна активність може служити ефективним засобом у лікуванні розладів настрою, таких як депресія та тривога, і покращує загальну якість життя.

Висновки. Анаеробні вправи активізують симпатoadреналову систему та гіпоталамо-гіпофізарно-надниркову систему, також підвищують секрецію тестостерону, що призводить до покращення процесів фізіологічної адаптації. Анаеробні вправи покращують настрій під час і після тренування за рахунок посилення синаптичної передачі моноамінів, які, ймовірно, діють за тим же принципом, що і антидепресанти. Фізична активність стимулює вивільнення бета-ендорфінів, які відповідають за відчуття спокою та покращення настрою після тренування.

Ключові слова: анаеробні навантаження, емоційний стан, стрес, кортизол, тестостерон.