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PREVALENCE OF CHRONIC FATIGUE AND CHRONIC FATIGUE SYNDROME IN UKRAINIAN ELITE ATHLETES: RESULTS FROM A POPULATION-BASED STUDY

A large group of high-level athletes, members of national and club teams of Ukraine in various sports, participated in the research: track and field, cycling, wrestling, swimming, freestyle, hockey, football, rowing, sports dancing, and rock climbing.

During the study, tests were conducted to identify signs of chronic fatigue, chronic fatigue syndrome and fibromyalgia.

After the analysis, it was found that out of 286 surveyed athletes, 101 (35,3%) showed no signs of current or chronic fatigue, while 169 (59%) exhibited symptoms of chronic fatigue. Among those showing signs of chronic fatigue, 71 (25%) had signs of the initial degree, 29 (10%) showed signs of expressed degree, and 17 (6%) exhibited signs of strong chronic fatigue. Additionally, it was observed that symptoms of chronic fatigue are more common in female athletes, with 49.0% of women compared to 37% of men experiencing them.

Analysis of the frequency of chronic fatigue symptoms across different sports disciplines revealed that athletes with signs of chronic fatigue are most commonly swimming (71% of all surveyed swimmers), track and field athletics (62%), and football (54%). Additionally, in football, track and field, wrestling, and cycling, a higher proportion of athletes with a strong degree of chronic fatigue were identified compared to other sports disciplines (16%, 12%, 8%, and 7%, respectively). Conversely, chronic fatigue syndrome was rarely encountered in sports such as freestyle and rock climbing.

Out of the athletes displaying signs of chronic fatigue of a severe and strong degree, there were 46 in total (20 women, 26 men). Upon analysis, it was discovered that symptoms of chronic fatigue syndrome (CFS) were detected in 30 of them (66.2%), while 3 (6.5%) were diagnosed with fibromyalgia. Among these 30 athletes with CFS symptoms, 13 (43.3%) were female athletes, and 17 (56.7%) were male athletes. Symptoms of fibromyalgia were noted in two (4.3%) male athletes and one (2.2%) female athlete.

Keywords: *high-level athletes, chronic fatigue, chronic fatigue syndrome, fibromyalgia*

Introduction. Currently, the technology for preparing high-level athletes relies on fundamental domains of knowledge concerning the functioning of humans in elite sports. without which it is impossible to construct an effective training process aimed not only at achieving high athletic performance but also at preserving athletes' health.

Modern high-performance sports involve extreme physical and psychological influences on athletes' bodies [1]. Excessive escalation of sports loads in high-level and elite sports is irrational, as it adversely affects athletes' health [2]. Unduly large volumes of work, aimed at increasing fitness, lead to the development of distress. As a consequence, "fluctuations" in the immune system occur, predisposing to pre-illness states and illnesses. As a result, over 50% of

athletes have deviations in their health status [3, 4]. According to conducted research, high-level athletes constitute a special group. In conditions of intensive and prolonged training and competitive loads, states characterized by the overstrain of functional systems of the body may occur, which can lead to the development of overtraining and the transition of favorable adaptive reactions to pre-pathological and even pathological changes in the body [5]. Overtraining is a chronic syndrome whose symptoms encompass both physiological and psychological manifestations [6, 7]. Overtraining occurs when an athlete consistently performs high training volume without sufficient rest between individual sessions: short intervals of rest between intense loads do not provide the necessary recovery of the body's strength. Overtraining development is facilitated by disruptions in the regime of life, work, and rest. Overstrain and overtraining frequently arise in high-level athletes [8, 9]. Overtraining is characterized as a disparity between load and recovery [6]. During periods of overstrain and overtraining, low-level disorders, bordering on pathological disturbances, are uncovered. These are accompanied by functional and sometimes organic changes in the athlete's body, resulting in significant and long-term decreases in performance and the development of acute and chronic fatigue [10].

In cases of chronic fatigue (CF) or fibromyalgia syndrome (FS), there are noticeable dystrophic and destructive changes in muscle fibers. One of the reasons for their occurrence is hypoxia and disturbances in tissue microcirculation of the musculoskeletal system. Increased excitability, mood swings, reluctance to train, and lethargy are often observed. The predominant inhibition processes, in turn, slow down the recovery processes. The main symptom of chronic fatigue is the deterioration of athletic performance. Accompanying manifestations of these changes can include sports injuries, depression, i and an ncreased susceptibility to infections [2]. In chronic fatigue, the necessary level of athletic performance can only be maintained temporarily due to an increase in biological cost and rapid expenditure of the body's functional reserves [5].

To counter adverse changes in the body's functions and maintain athletic performance, it's crucial to address violations of training and rest schedules and provide athletes with additional rest. Failing to adhere to these measures can result in the development of chronic fatigue syndrome [11]. This is supported by numerous studies demonstrating that in high-level athletes, the emergence of acute and chronic fatigue under prolonged, intensive physical and psychological stress can lead to chronic fatigue syndrome [12, 13]. This progression is typically preceded by early changes in the functional, psychophysiological, and mental state along with, the development of overtraining and chronic fatigue.

Continuous monitoring of athletes' functional state against the background of intensive, extensive training loads is necessary. In case of early signs of chronic fatigue, if corrective measures are not taken in the training process, more serious and multifunctional changes occur in the tissues of the musculoskeletal system, cardiac muscle, and other organs and systems. Identifying these early changes can contribute to identifying risk groups and developing methods for preventing chronic fatigue and chronic fatigue syndrome based on correction of training loads [14].

Materials and methods. The article is based on scientific data published in domestic and foreign literature, as well as materials from multi-year research conducted by the authors at the National University of Physical Education and Sport of Ukraine, at the State Scientific Research Institute of Physical Education and Sport, at the O.O. Bogomolets Institute of Physiology of the National Academy of Sciences of Ukraine, and at the International Center for Astronomical and Medical-Ecological Research of the National Academy of Sciences of Ukraine. A large group of high-level athletes, members of national and club teams of Ukraine in various sports, participated in the research: track and field, cycling, wrestling, swimming, freestyle, hockey, football, rowing, sports dancing, and rock climbing.

During the investigation to identify signs of chronic fatigue and assess its severity among athletes, the Leonov's questionnaire "Determination of the Degree of Chronic Fatigue" [15] and the Neil-Gordon questionnaire) [3] were used.

Additionally, an express test was employed to ascertain the presence of chronic fatigue syndrome and fibromyalgia, using clarified criteria for diagnosing fibromyalgia as adopted by the American College of Rheumatology (ACR) in 2011: a generalized pain index (WPI) exceeding 7 and a severity of symptoms (SS) surpassing 5 [16].

Results. The frequency and severity of chronic fatigue symptoms were assessed using the Leonov questionnaire "Determination of the degree of chronic fatigue," which comprises 36 questions including 6 "direct" and 30 "indirect" ones. After calculating the overall scores, they were interpreted as follows: 0–17 points indicate an absence of chronic fatigue symptoms; 18–26 points suggest an initial degree of chronic fatigue; 27–37 points indicate a expressed degree of chronic fatigue; 38–48 points signify a strong degree of chronic fatigue; and 49 points and above suggest the transition of chronic fatigue into a pathological condition (chronic fatigue syndrome). The study involved 286 qualified athletes (118 females, 168 males) ranging from 16 to 37 years old, holding titles such as (Candidate Master of Sports, Master of Sports, Master of Sports International Class,, Honored Master of Sports). They were members of national and club teams of Ukraine, specializing in ten different sports disciplines.

During the processing questionnaire data, a differentiation was made between current fatigue and chronic fatigue (CF). In this case symptoms of current fatigue were observed over several days, whereas chronic fatigue persisted for 30 days or more..

After analyzing the data, it was discovered that out of 286 surveyed athletes, 101 (35.3%) displayed no signs of current or chronic fatigue, while 169 (59%) exhibited symptoms of chronic fatigue, Among those showing signs of chronic fatigue, 71 (25%) displayed symptoms of the initial degree, 29 (10%) showed signs of a expressed degree of chronic fatigue, and 17 (6%) exhibited signs of strong chronic fatigue. Additionally, the analysis revealed that symptoms of chronic fatigue are more prevalent among female athletes, with 49.0% of women experiencing symptoms compared to 37% of men (refer to Figure 1).

This finding aligns with existing literature [17]. Concurrently, it was discovered that a severe degree of chronic fatigue is more prevalent in men (10%) than women (1%). This discrepancy could be attributed to the higher representation of men in sports characterized by intense physical demands, such as wrestling, football, and hockey. An analysis of the frequency of chronic fatigue symptoms across different sports disciplines revealed that athletes with exhibiting signs of chronic fatigue are most commonly found in swimming (71% of all surveyed swimmers), track and field athletics (62%), and football (54%). In football, track and field athletics, wrestling, and cycling, a higher proportion of athletes with a strong degree of chronic fatigue were identified compared to other sports disciplines (16%, 12%, 8%, and 7%, respectively). Conversely, chronic fatigue syndrome was rarely encountered in sports like freestyle and rock climbing (refer to Figure 2).

The data suggests that in sports such as football, track and field athletics, swimming, wrestling, and hockey, training and competitive loads for individual athletes may face excessively high training and competitive loads, leading to slowed recovery processes in their bodies.

Coaches, methodologists, and medical staff should pay attention to the need for adjusting the structure and intensity of training sessions for these athletes. They should also ensure the consistent and comprehensive implementation of methods and strategies for sports performance recovery, including aspects like daily routines and monitoring the functional state of the body's systems, especially in sports disciplines with the highest frequency of chronic fatigue manifestations Furthermore, it's crucial to incorporate means aimed at enhancing the body's nonspecific resistance throughout all stages of the training and competitive processes [18]. Recovery methods means should be integrated into the overall athlete's training plan of athletes, closely linked with the general organization of the training regimen.

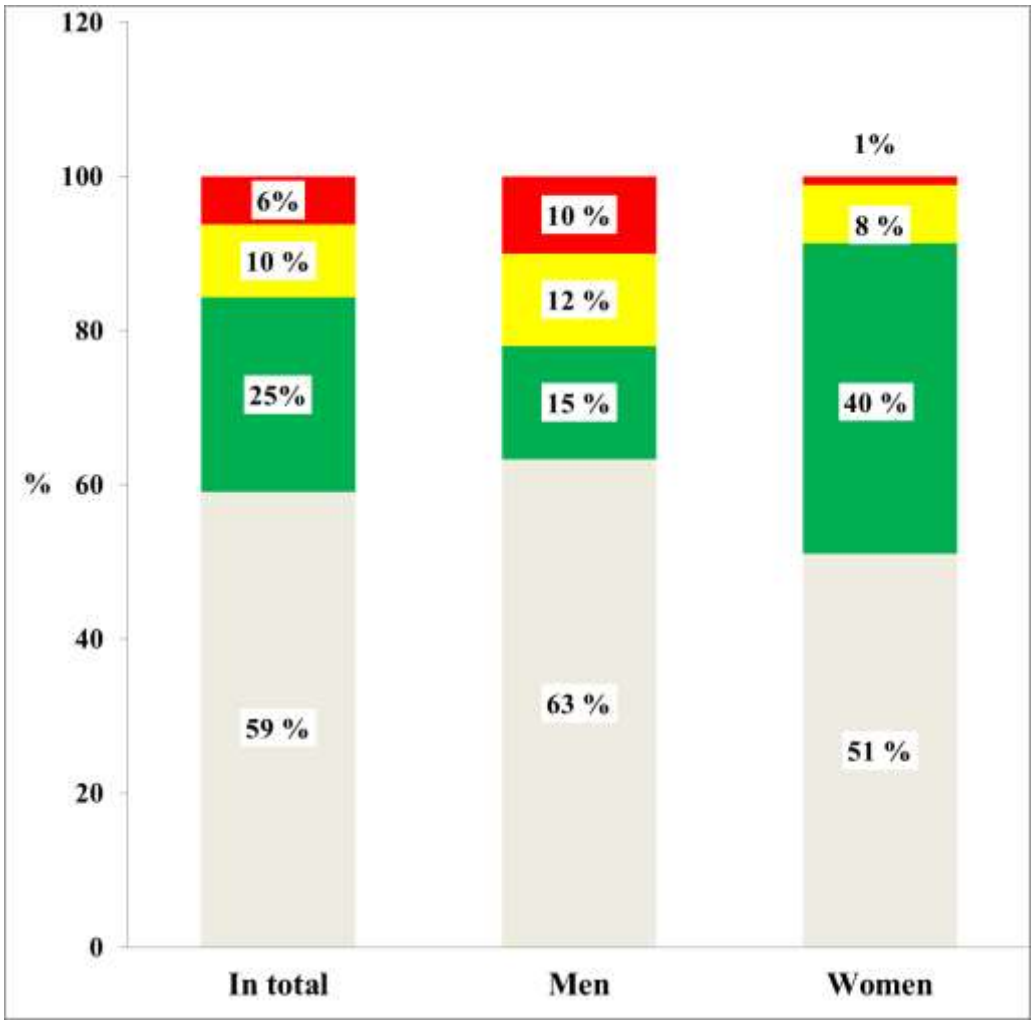

Fig. 1. Frequency in % of manifestations of signs of chronic fatigue of various degrees in interviewed athletes in general and separately for men and women:

– absence of CF; – initial degree of CF;

– expressed degree of CF; – strong degree of CF

The study also delved into investigated the frequency of chronic fatigue symptoms based on the athlete's qualification level. The results are depicted in Figure 3. It's evident that as sports qualification rises, there's a slight increase of 3–4% in the number of athletes displaying signs of chronic fatigue.

However, when compared to Candidate Masters of Sports (6%), both among Masters of Sports and Masters of Sports International Class, exhibit a higher prevalence of athletes with a expressed and strong degree of chronic fatigue increases (16% and 18%, respectively).

Conversely, only, in a very small proportion number of Honored Masters of Sports (2%), showed signs of a pronounced degree of chronic fatigue with no signs of severe fatigue observed.

To identify chronic fatigue syndrome (CFS) among highly qualified athletes with signs CF of a expressed and strong degree, an express test containing three typically indicated the presence of chronic fatigue syndrome simple questions was used. Affirmative responses to these three questions, then most likely they had chronic fatigue syndrome. For diagnosing fibromyalgia, the criteria established by the American College of Rheumatology (ACR) were employed, incorporating the widespread pain index (WPI) and symptom severity scale (SS) [16].

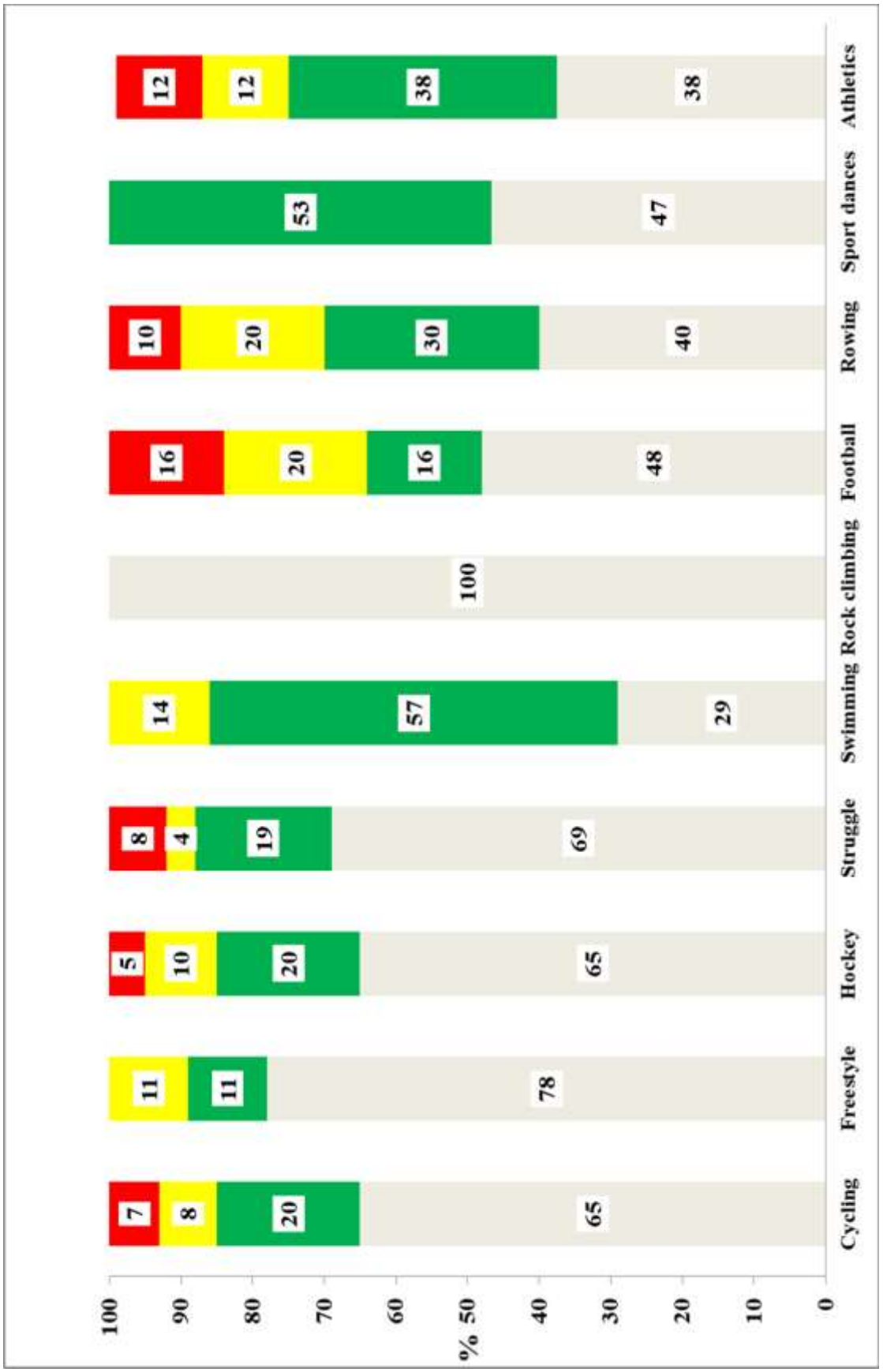

Fig. 2. The frequency of manifestations of signs of chronic fatigue in athletes in various sports:
– absence of CF; – initial degree of CF; – expressed degree of CF; – strong degree of CF

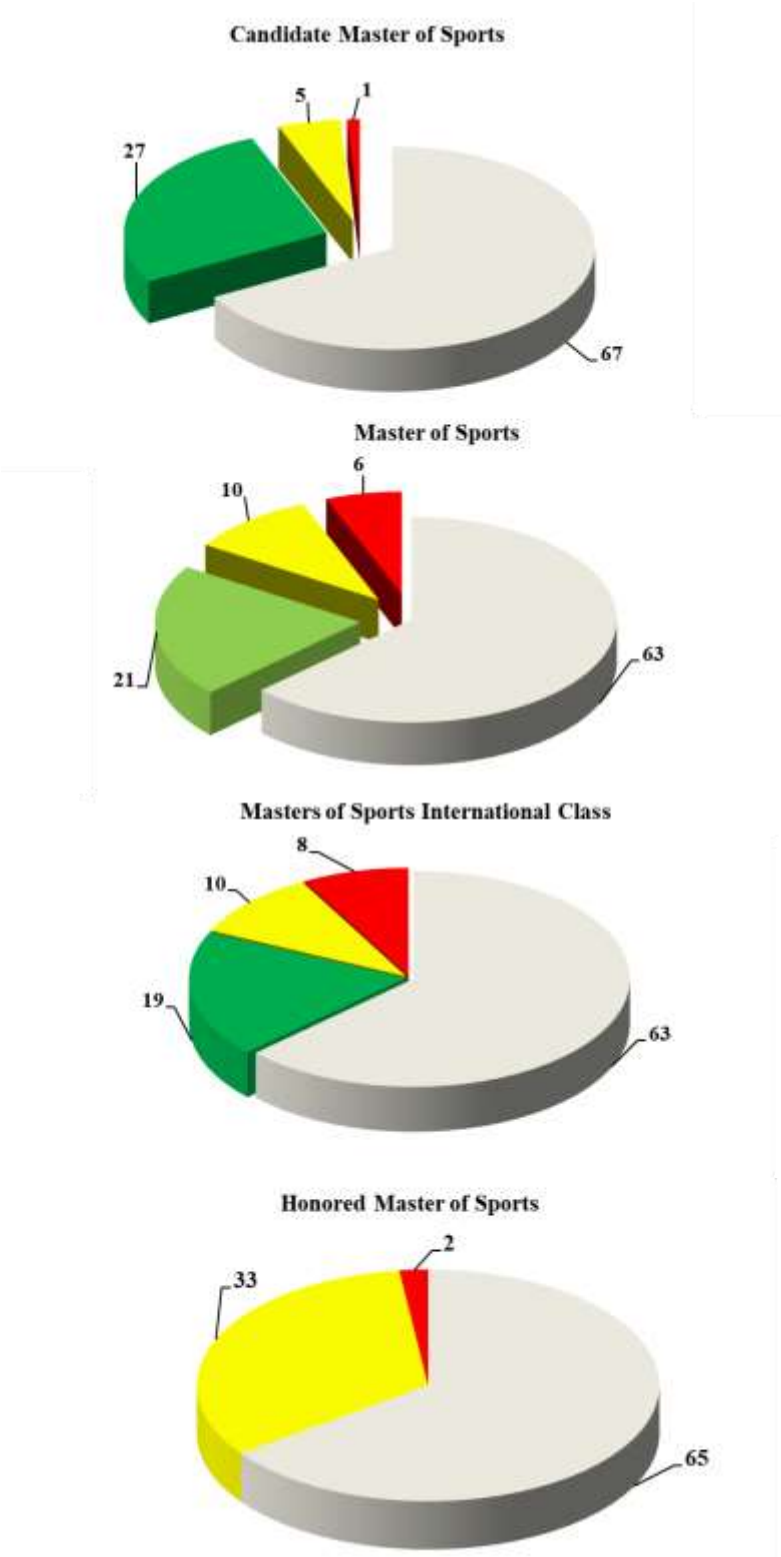

Fig. 3. Frequency in % of manifestations of chronic vomiting in athletes of various qualifications: Candidate Master of Sports (CMS), Master of Sports (MS), Masters of Sports International Class (IMS), Honored Master of Sports (HMS)

– absence of CF; – initial degree of CF;

– expressed degree of CF; – strong degree of CF

Among the athletes exhibiting signs of chronic fatigue of a expressed and strong degree was 46 in total, including 20 women and 26 men. The analysis revealed that 30 of them (66.2%) displayed symptoms indicative of chronic fatigue syndrome (CFS), while 3 (6.5%) were diagnosed with fibromyalgia. Of these 30 athletes with symptoms of CFS, 13 (43.3%) were female athletes, and 17 (56.7%) were male athletes. Additionally, symptoms of fibromyalgia were observed in two (4.3%) male athletes and one (2.2%) female athlete.

The data analysis revealed that symptoms of chronic fatigue syndrome (CFS) occur more frequently in male athletes than in female athletes – in 56.7% of men displaying symptoms compared to 43.3% of women (refer to Figure 4). This trend can be attributed to the higher percentage of male athletes with severe and pronounced CFS symptoms (22%) compared to women (9%) (see Fig. 1).

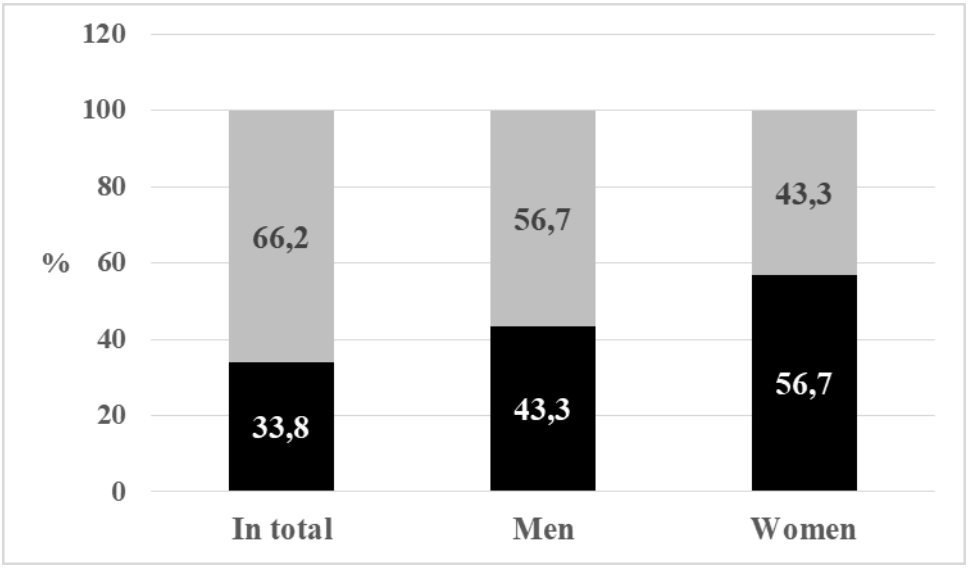

Fig. 4. Frequency of presence in percentage of chronic fatigue syndrome in athletes with signs of severe and severe chronic fatigue:

– absence of CFS – availability of CFS.

These findings suggest that in athletes with expressed and strong degrees of chronic fatigue, there is a increased risk of progressing from chronic fatigue to CFS without preventive measures. In highly qualified athletes, the development of chronic fatigue syndrome may precede specific stages common in elite sports: tension, fatigue, overfatigue, overstrain, overtraining, and chronic fatigue from initial to severe degrees [19, 20, 21].

The analysis of the appearance of CFS depending on the athletes' qualification confirmed the conclusions made above. With an increase in sports qualification, the number of athletes with signs of chronic fatigue increases slightly. This conclusion fully applies to the frequency of CFS occurrence (see Figure 5).

Discussion. Chronic fatigue and chronic fatigue syndrome are characterized by a deterioration in health due to overstrain and overtraining and are characterized by symptoms such as: decreased sports performance, depression, sleep disturbances, high susceptibility to upper respiratory tract infections, slight malaise, irritability, fluctuating weight loss, general fatigue, increased heart rate under stress, reduced at rest, heart arrhythmia.

Chronic fatigue and chronic fatigue syndrome in athletes do not develop immediately. They are preceded by the development of various degrees of fatigue. Chronic fatigue syndrome is a chronic fatigue that occurs for no apparent reason and is felt by a person for 30 days or more [22, 23]. There comes a moment when the functional reserves of the body associated with fatigue or

overtraining are exhausted [1]. Complaints typical of chronic fatigue are intensified. These include: rapid fatigue, significant fatigue that does not disappear after a night's rest, increased drowsiness, loss of appetite, sleep disturbances, loss of interest in work, muscle pain, headache, apathy, often depression, impatience, irritability, vague anxiety.

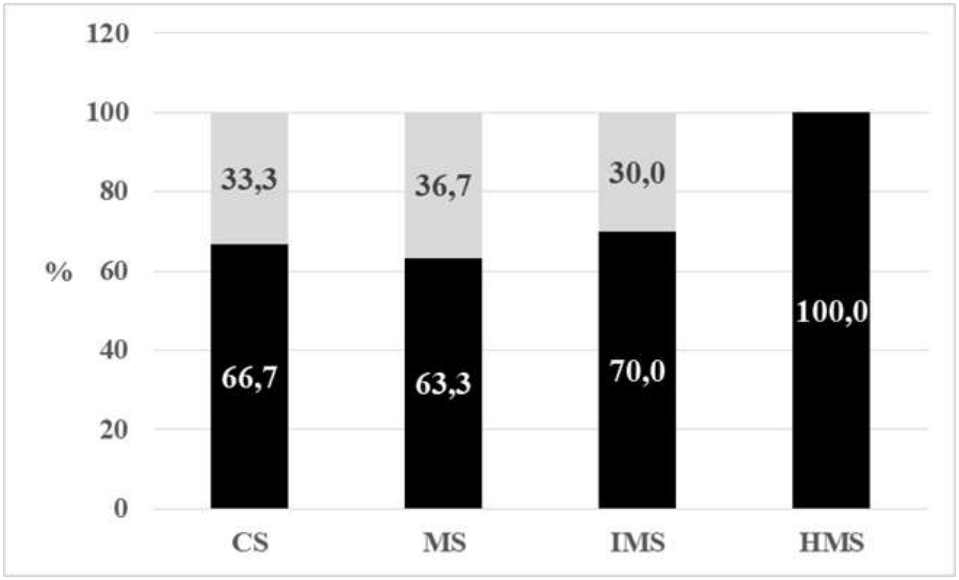

Fig. 5. Frequency of presence in percentage of chronic fatigue syndrome in athletes of different qualifications: CMS, MS, IMS and HMS:

– absence of CFS – availability of CFS.

In high-level athletes, the development of chronic fatigue syndrome may be preceded by specific stages specific to elite sports: tension, fatigue, overwork, overstrain, overtraining, chronic fatigue. Tension and fatigue are normal functional states associated with physical exertion. Overwork occurs due to an irrational work and rest regime and is a consequence of piling up successive loads without sufficient recovery from previous ones. In individual cases, overwork can be an additional stimulus for mobilizing hidden reserves and developing a delayed training effect [6]. Overstrain occurs with a clear discrepancy between physical loads and the athlete's functional abilities and can manifest itself in pathological changes in various organs and systems. Overtraining is considered a condition caused by overstrain of neurohumoral regulation mechanisms leading to disruption of adaptive processes and the transition of favorable changes in the body to pre-pathological and pathological ones.

Overwork and overtraining are symptoms of neurosis, characterized by the presence of somatic and vegetative disturbances; neurotic reactions that usually occur during monotonous, prolonged, varied, and repeated training sessions (2-3 times a day), leading to constant emotional tension, deterioration of the nervous-psychic and physical state, decreased sports and overall performance. Overwork and overtraining often overlap, resulting in a symptom complex of organism activity disturbances. Overwork disrupts the coordination of interaction between the cerebral cortex, lower parts of the nervous system, and internal organs [12].

This condition is closely related to the development of chronic fatigue and chronic fatigue syndrome in athletes. The state of overtraining is identical to a certain nosological form of illness, the pathophysiological basis of which is not structural but functional disorders of the nervous system [6]. The symptoms of overtraining are very similar to those of chronic fatigue and chronic fatigue syndrome. The boundary between them is very thin

The formation of chronic fatigue and chronic fatigue syndrome in athletes can also be caused by: irrational use of physical loads (training), which can lead to functional stress on the

musculoskeletal tissues; excessive physical exertion during training in upland and hot and humid climate zones, leading to exacerbation of chronic diseases or overstrain of the cardiorespiratory system; sharp increase in energy expenditure during intensive muscle work, resulting in more intense oxidation of substances in muscle tissue, increased oxygen delivery to skeletal muscles. If there is not enough oxygen for complete oxidation of substances, it occurs partially, and a large amount of underoxidized products, such as lactic and pyruvic acids, urea, and others, accumulates in the body. This leads to deviations in several important constants of the body's internal environment, which prevent it from continuing muscle activity (work). As a result, the development of chronic fatigue and chronic fatigue syndrome in athletes is characterized by the gradual onset of a state of stable or recurrent significant fatigue or rapid fatigue, which does not disappear during the usual recovery period after training loads and even full rest, when fatigue becomes a frequent or constant "companion". . As a result, a decrease in the usual level of activity is observed over a long period of time (more than a month).

In athletes with increased chronic fatigue, indicators characterizing their functional, psychophysiological, and physical condition deteriorate. However, chronic fatigue syndrome may not develop in an athlete if they do not have a genetic predisposition and if triggering endogenous and exogenous factors are absent, which, according to various authors, are realized through the nervous system and lead to the appearance of clinical symptoms [24, 25].

Thus, as a result of the analysis of literature and own data, it is assumed that the basis of the formation of chronic fatigue and chronic fatigue syndrome in qualified athletes are violations of the main regulatory systems of the body - nervous, endocrine and immune. Trigger factors for the development of these pre- and pathological conditions can be various endogenous (intense physical and psychological stress, dietary habits, medications, environmental ecology) and exogenous (hormones, tension, stress, inflammatory mediators) influences. Moreover, in athletes, these conditions may be preceded by certain stages specific to elite sports: tension, fatigue, overwork, overstrain, overtraining.

Conclusions.

1. After the analysis, it was found that out of 286 surveyed athletes, 101 (35.3%) showed no signs of current or chronic fatigue, while 169 (59%) exhibited symptoms of chronic fatigue. Among those showing signs of chronic fatigue, 71 (25%) had signs of the initial degree, 29 (10%) showed signs of a pronounced degree, and 17 (6%) exhibited signs of severe chronic fatigue. Additionally, it was observed) that symptoms of chronic fatigue are more common in female athletes, with 49.0% of women compared to 37% of men experiencing them.

2. Analysis of the frequency of chronic fatigue symptoms across different sports disciplines revealed that athletes with signs of chronic fatigue are most commonly swimming (71% of all surveyed swimmers), track and field athletics (62%), and football (54%). Additionally, in football, track and field athletics, wrestling, and cycling, a higher proportion of athletes with a severe degree of chronic fatigue were identified compared to other sports disciplines (16%, 12%, 8%, and 7%, respectively). Conversely, chronic fatigue syndrome was rarely encountered in sports such as freestyle wrestling and rock climbing.

3. It's noticeable that with an increase in sports qualification, there's a slight rise of 3–4% in the number of athletes showing signs of chronic fatigue. However, compared to Candidate Masters of Sports (6%), among Masters of Sports and International Masters of Sports, the number of athletes with a pronounced and severe degree of chronic fatigue increases (16% and 18%, respectively). Conversely, in a very small percentage number of Honored Masters of Sports (2%), signs of a pronounced degree of chronic fatigue were found, while signs of severe fatigue were absent.

4. Out of the athletes displaying signs of chronic fatigue of a expressed and strong degree, there were 46 in total (20 women, 26 men). Upon analysis, it was discovered that symptoms of

chronic fatigue syndrome (CFS) were detected in 30 of them (66.2%), while 3 (6.5%) were diagnosed with fibromyalgia. Among these 30 athletes with CFS symptoms, 13 (43.3%) were female athletes, and 17 (56.7%) were male athletes. Symptoms of fibromyalgia were noted in two (4.3%) male athletes and one (2.2%) female athlete.

Conflict of interest. The authors have no conflicts of interest to declare.

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