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THE USE OF WHOLE-BODY CRYOTHERAPY FOR INCREASING THE STRESS RESISTANCE OF FEMALE ATHLETES IN GROUP TYPES OF GYMNASTICS

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Background. Representatives of complex coordination sports are most susceptible to psychoemotional stress, since they demonstrate high sports results already at a young age. The tightening of anti-doping control has significantly reduced the possibility of using pharmacological and biologically active drugs to speed up the recovery of athletes. Against this background, in sports medicine, more attention is paid to the use of non-drug methods to improve performance and recovery in athletes.

Aim – to study the efficiency of the introduction of whole-body cryotherapy in the training process of female athletes of complex coordination sports (for example, group gymnastics) to increase stress resistance and reduce violations of adaptation processes as a result of neuropsychiatric overstrain.

Materials and methods. During the academic-training year, 22 gymnasts received six ten-day courses of whole-body cryotherapy in the ICEQUEEN cryosauna. 19 athletes were included in the control group. The studies were conducted 3 times: before the start of the procedures, after the first course of procedures, at the end of the training year. The diagnosis of nocturnal bruxism and the definition of the “psychological component of health” were carried out. Total and effective albumin concentrations were determined in the blood serum with the calculation of the albumin binding reserve, helper T-lymphocytes and killer T-lymphocytes with the calculation of the immunoregulatory index.

Results. After one course, there was an increase in the functional activity of serum albumins, a decrease in the number of episodes of involuntary contractions of the masticatory muscles at night, and an increase in the “psychological component of health” according to SF-36. After six courses of cryotherapy, the functional activity of serum albumins and the initial values of the immunoregulatory index were preserved by the end of the season, and the “psychological component of health” according to SF-36 was increased, while these indicators decreased in the control group. There was also a decrease in the number of episodes of involuntary contractions of the masticatory muscles at night with an increase in their number in the control group of female athletes.

Conclusions. Considering the obtained results, it is possible to recommend the use of whole-body cryotherapy in gymnasts during the preparatory and recovery periods of the annual training cycle in order to increase stress tolerance and prevent psychoemotional overstrain.

Keywords: gymnast; psychoemotional stress; overexertion; prevention; whole-body cryotherapy.

ИСПОЛЬЗОВАНИЕ КРИОТЕРАПИИ ДЛЯ ПОВЫШЕНИЯ СТРЕССОУСТОЙЧИВОСТИ СПОРТСМЕНОВ В ГРУППОВЫХ ВИДАХ ГИМНАСТИКИ

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Введение. Представительницы сложнокоординационных видов спорта наиболее подвержены психоэмоциональному стрессу, так как высокие спортивные результаты они демонстрируют уже в юном возрасте. Ужесточение антидопингового контроля значительно снизило возможность применения фармакологических и биологически активных препаратов для ускорения восстановления спортсменов. На этом фоне в спортивной медицине все большее внимание уделяется использованию немедикаментозных методов повышения работоспособности и восстановления у спортсменов.

Цель исследования – изучить эффективность введения общей воздушной криотерапии в тренировочный процесс спортсменов сложнокоординационных видов спорта (на примере групповых видов гимнастики) для повышения стрессоустойчивости и снижения нарушений процессов адаптации в результате нервно-психического перенапряжения.

Материалы и методы. На протяжении учебно-тренировочного года 22 гимнасткам было проведено шесть десятидневных курсов общей воздушной криотерапии в криосауне ICEQUEEN. 19 спортсменов были включены в контрольную группу. Исследования проводились 3 раза: до начала процедур, после первого курса процедур, в конце учебно-тренировочного года. Проводилась диагностика ночного бруксизма и определение «психологического компонента здоровья». В сыворотке крови определялись: общая и эффективная концентрации альбуминов с расчетом резерва связывания альбуминов, Т-лимфоциты хелперы и Т-лимфоциты киллеры с расчетом иммунорегуляторного индекса.

Результаты. После одного курса установлено повышение функциональной активности сывороточных альбуминов, снижение количества эпизодов непроизвольных сокращений жевательных мышц ночью и повышение «психологического компонента здоровья» по SF-36. После прохождения шести курсов криотерапии было отмечено сохранение к концу сезона функциональной активности сывороточных альбуминов и исходных значений иммунорегуляторного индекса, повышение «психологического компонента здоровья» по SF-36 при снижении этих показателей в контрольной группе. Зафиксировано снижение количества эпизодов непроизвольных сокращений жевательных мышц ночью при увеличении их количества в контрольной группе спортсменов.

Заключение. Учитывая полученные результаты, можно рекомендовать применение у гимнасток общей воздушной криотерапии в подготовительный и восстановительный периоды годового тренировочного цикла с целью повышения стрессоустойчивости и профилактики психоэмоционального перенапряжения.

Ключевые слова: гимнастка; психоэмоциональный стресс; перенапряжение; профилактика; общая воздушная криотерапия.

BACKGROUND

The results demonstrated by athletes in competitions are now approaching the limits of human capabilities. An athlete is not always able to control his/her emotional experiences, which can cause excessive neuropsychic stress and chronic psychoemotional stress [1, 6].

The most pronounced psychoemotional stress is registered in female athletes in such complex coordination sports as rhythmic and aesthetic gymnastics, which is associated with the specifics of the selection of the most artistic and emotional girls. At the same time, group gymnastics is characterized by the high individual responsibility of each gymnast, which in presence of pronounced psychoemotional stress can cause chronic psychoemotional stress and thus affects adversely the health of the gymnasts, efficiency of the training process, and competitive activity. In this regard, an important task of recovery procedures at all stages of training athletes in complex coordination sports is an increase in mental stability.

According to the literature, sleep bruxism can be considered a traceable clinical symptom and is an indicator of stress [3, 14, 16] and anxiety [4, 21]. For objective diagnostics of sleep bruxism, hardware methods are used. A significant correlation was found between stress and sleep bruxism index, assessed using the Bruxo device [23]. The relationship between stress and degree of nocturnal bruxism

in well-trained athletes was established by Russian authors using the BiteStrip device [6].

As prognostic criteria for the risk of the development of organic anxiety disorders at an early disease stage, along with other methods, the recommendation was to decrease the immunoregulatory index (IRI) as a result of a decrease in the number of T-helper inducers (CD4⁺ phenotype) and an increase in the level of cytotoxic T-suppressors (CD8⁺ phenotype) [10].

In patients diagnosed with endogenous intoxication, shifts in homeostasis characteristic of chronic stress were established [8, 12]. One of the universal mechanisms of the body's response to an increase in metabolic products is the formation of complexes of various compounds with blood plasma albumins. It has been hypothesized that endogenous intoxication is an integral component of the pathogenesis of mental disorders [11].

An adequate balance between stress (training and competition load, other vital needs) and recovery is important for athletes to consistently achieve high results. Recovery after training and competition is a complex process and usually depends on the nature of the exercise performed and external stressors [17].

We have to take into account that tightening of anti-doping control has significantly reduced the possibility of using pharmacological and biologically active drugs to accelerate the recovery of ath-

letes. In this situation, in sports medicine, increasing is paid to the use of non-drug methods to improve performance and recovery in athletes. However, this is not only a problem of sports medicine, but also a social problem of the nation's health improvement, to ensure a decrease in the pharmacological load through the use of non-drug means of health improvement. These methods include cryotherapy [18, 19], and its safety has also been established in children and adolescents [13].

Whole-body air cryotherapy (WBAC) in athletes is mainly investigated to restore physical performance and treating injuries.

After intense physical exertion, WBAC causes a decrease in the level of markers of muscle damage and a decrease in the concentration of myostatin with an increase in isokinetic muscle strength [15].

Under WBAC, the severity of tissue hypoxia decreases and aerobic metabolism of erythrocytes increases; thus, this method is recommended to increase endurance and resistance to the hypoxic factor. Microcirculation conditions are improved by restructuring the peripheral link of blood circulation due to a decrease in arterial blood flow and vascular tone. An increase in the lipid fluidity in plasma membranes of blood cells after a course of whole-body gas cryotherapy can affect the structure and function of membrane proteins, as well as lipid-protein interactions in the membrane. Moreover, the malondialdehyde level decreased. There is a long-term stimulation of the body's antioxidant defense systems and the intensity of metabolic processes during cryotherapy [7].

The beneficial effect of cryotherapy on the immune system and hormonal and metabolic status has been established [20]. The biological effect of cryotherapy is based on the phenomenon of cross adaptation, when adaptation to cold increases the body's resistance to other stressors [5]. A study reported the effect of WBAC on the reduction of the inflammatory process and oxidative stress [24]. WBAC was demonstrated to be effective as an adjunct therapy to pharmacological treatment for depression [22].

However, regarding the effect of cryotherapy on physical recovery, very few studies have extensively focused on the role of cryotherapy in increasing the psychological adaptation and stress resistance of athletes.

This study aimed to analyze the efficiency of WBAC introduction into the training process of female athletes of complex coordination sports (such as group gymnastics) to increase stress resistance

and reduce disorders of adaptation processes following a neuropsychic overstrain.

MATERIALS AND METHODS

Practically healthy athletes aged 14–16 (14.8 ± 0.09) years, specializing in group gymnastics (aesthetic gymnastics, $n = 23$; group rhythmic gymnastics exercises, $n = 18$), were examined. According to the results of an annual medical examination, all athletes were engaged in sports.

The study fulfilled the requirements of the World Medical Association Declaration of Helsinki on Ethical Principles for Scientific Medical Research Involving Human Subjects as amended in 2000 and Rules of Good Clinical Practice in the Russian Federation approved by order of the Ministry of Health of the Russian Federation (No. 200n* dated 01.04.2016). The study was approved by the ethical committee of the Saint Petersburg State Pediatric Medical University. Informed consent was obtained from the parents, coach, and athletes themselves for the publication of the data obtained without personal identification.

The randomization procedure for distributing the gymnasts into experimental and control groups was performed by the closed-envelope method. The experimental group included 22 athletes, and the control group included 19 participants.

The work design consisted of three studies in two phases:

Stage 1 (start of the academic and training year) included the following:

1) Special preparatory period 1 before exposure to WBAC.

2) Special preparatory period 1 after exposure to a 10-day course of WBAC.

Stage 2 (end of the academic and training year) included the following:

3) The recovery period at the end of the competition.

The experimental group received six courses of WBAC (cryosauna ICEQUEEN, GRAND-CRYO, Russia) in one academic and training year (two courses in two special preparatory periods before major competitions and four courses in four recovery periods). A conventional procedure was used. For 15 s, the temperature of the gas around the body was fixed at 110°C – 120°C , and the procedure was performed for 120 s. The control group did not receive the WBAC.

To diagnose neuropsychic overstrain, a complex of studies was performed, including psychological, dental, immunological, and biochemical methods.

* <https://cdnimg.rg.ru/pril/130/47/73/43357.pdf>.

1. Determination of the psychological component of health. The method of the subjective assessment of the health-related quality of life (SF-36) in Russian was created and recommended by the Multi-national Center for Quality of Life Research [9].

2. Episodes of involuntary contractions of the masticatory muscles at night (nocturnal bruxism) were considered one of the markers of psychoemotional stress in athletes [6, 23]. To diagnose nocturnal bruxism, the BiteStrip device (“Up 2 dent”) was attached to the cheek (motor point of the lower jaw) by the athlete herself before going to sleep. In the morning, after removing the device, the number of involuntary contractions corresponding to a certain disease severity was recorded, and degree 1 of nocturnal bruxism occurs if there are 74–100 contractions [2].

3. A decrease in the IRI [10], which reflects the ratio of helper T-lymphocytes to killer T-lymphocytes, is used as prognostic criteria for the risk of anxiety disorders at an early stage. Counts of helper (CD4) and killer (CD8) lymphocytes were determined using a microlymphocytotoxic test with monoclonal antibodies to CD4 and CD8 antigens (“Ortho”).

Chronic stress is accompanied by endogenous intoxication [11, 12]. One of the indicators of endogenous intoxication is a decrease in the functional activity of serum albumin. In this regard, to determine the adaptive capabilities of the organism, the total and effective albumin concentrations (TAC and EAC, respectively) were determined (stationary fluorescence spectroscopy using a K-35 fluorescent probe) with the calculation of the albumin binding reserve (ABR) ($ABR = EAC / TAC \times 100$).

For laboratory studies, blood samples were collected in the morning, before training, from a peripheral vein into a vacuum container. Statistical data processing was performed using nonparametric method of statistics (Wilcoxon T -test).

RESULTS AND DISCUSSION

High physical exertion causes an increase in the levels of metabolites. The body’s ability to eliminate them characterizes the adaptive capabilities of the athlete. The functional activity of serum albumin determines the efficiency of cleansing the body from metabolites.

Endogenous intoxication disrupts the adaptive reactions of the body and can be triggered not only by physical but also by emotional stress [11]. To determine the disturbances in the disposal of metabolic products, an integrative indicator, ABR, was used, which characterizes the proportion of free albumin centers not blocked by metabolites.

During a 10-day WBAC course, ABR was increased in 19 female athletes. To establish the significance of the differences before and after the experiment, the Wilcoxon T -test was used. In this case, the empirical value of T was in the zone of significance with $T_{emp} < T_{cr}$ (0.01) (Table 1). Thus, a significant increase in ABR was recorded after a 10-day WBAC course.

In the control group, no significant decrease was found in the ABR value in six cases, and no significant increase was noted in five cases. In this case, the empirical value of T was in the zone of insignificance with $T_{emp} > T_{cr}$ (Table 1). Thus, the indicators tended to remain at the same level.

Table 1 / Таблица 1

Average values of the albumin binding reserve before and after a 10-day course of whole-body cryotherapy in the experimental group of female athletes relative to female athletes of the control group
Средние значения резерва связывания альбуминов до и после 10-дневного курса общей воздушной криотерапии в экспериментальной группе спортсменов относительно спортсменов контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{emp} / T_{эмп}$ ($\sum R_i$)	$T_{cr} / T_{кр}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 2 / 2-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	90.45 (95–87)	92.52 (96–90)	17.5	55	<0.01
Control / Контрольная ($n = 19$)	91.36 (95–88)	91.31 (94–87)	70	37	>0.05

Note. M – average value; $\sum R_i$ – the sum of the ranks of atypical shifts; T – Wilcoxon test; T_{emp} – an empirical meaning; T_{cr} – critical value at $p < 0.01$ (in accordance with tables of critical values); p – statistical significance of differences.

Примечание. Здесь и в табл. 2–8. M — среднее значение; $\sum R_i$ — сумма рангов нетипичных сдвигов; T — критерий Вилкоксона; $T_{эмп}$ — эмпирическое значение; $T_{кр}$ — критическое значение при $p < 0,01$ (в соответствии с таблицами критических значений); p — статистическая значимость различий.

Table 2 / Таблица 2

Average values of the albumin binding reserve at the beginning and the end of the academic-training year in the gymnasts of the experimental group who underwent whole-body cryotherapy courses and the gymnasts of the control group
Средние значения резерва связывания альбуминов в начале и конце учебно-тренировочного года у гимнасток экспериментальной группы, проходивших курсы общей воздушной криотерапии, и гимнасток контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R_i$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 3 / 3-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	90.45 (95–87)	90.8 (93–89)	79	75	>0.05
Control / Контрольная ($n = 19$)	91.36 (95–88)	89.5 (94–86)	19	37	<0.01

Table 3 / Таблица 3

Average values of the immunoregulatory index in the gymnasts of the experimental group before and after a 10-day course of whole-body cryotherapy relative to the control group of gymnasts
Средние значения иммунорегуляторного индекса у гимнасток экспериментальной группы до и после 10-дневного курса общей воздушной криотерапии относительно контрольной группы гимнасток

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R_i$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 2 / 2-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	1.18 (1.5–0.9)	1.17 (1.5–1)	89.5	55	>0.05
Control / Контрольная ($n = 19$)	1.15(1.5–1.0)	1.16 (1.4–1.0)	75	37	>0.05

As no ABR changes occurred in the control group after a 10-day follow-up period, an increase in the ABR was noted in the experimental group, which was influenced by the WBAC course.

During the third examination in the experimental group at the end of the academic and training year, no significant decrease in ABR was noted in five female gymnasts. The empirical value of T was in the zone of insignificance with $T_{\text{emp}} > T_{\text{cr}}$ (Table 2). A possible conclusion is that the indicators tended to remain at the same level. Thus, in the experimental group, the ABR was not decreased at the end of the academic and training year.

In the control group, the third examination revealed a decrease in ABR in 12 gymnasts and an increase in only two gymnasts. The obtained empirical value T was in the zone of significance with $T_{\text{emp}} < T_{\text{cr}}$ (0.01) (Table 2). Accordingly, at the end of the academic and training year, the control group had a decrease in ABR, indicating an impairment of functioning of the serum albumin system.

Thus, after one WBAC course, there was a decrease in the level of metabolites and an acceleration of detoxification processes in athletes [4], which leads to the release of a high number of free centers of albumin and, accordingly, to their greater functional activity, which is expressed in an increase in the ABR index.

WBAC courses throughout the annual training cycle not only reduce the level of psychoemotional stress but also maintain the functional activity of the serum albumin system, preventing it from decreasing below the initial level.

The study of the effect of a 10-day WBAC course on the IRI showed its increase in six cases and a decrease in 10 cases. The empirical value of T was in the zone of insignificance with $T_{\text{emp}} > T_{\text{cr}}$ (Table 3). No significant decrease in IRI was found in the experimental group. In the control group, significant changes in IRI were also not found ($T_{\text{emp}} > T_{\text{cr}}$) (Table 3).

Table 4 / Таблица 4

Average values of the immunoregulatory index at the beginning and the end of the academic-training year in gymnasts of the experimental group who underwent whole-body cryotherapy courses and gymnasts of the control group

Средние значения иммунорегуляторного индекса в начале и конце учебно-тренировочного года у гимнасток экспериментальной группы, проходивших курсы общей воздушной криотерапии, и гимнасток контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 3 / 3-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	1.18 (1.5–0.9)	1.2 (1.5–1.0)	70	55	>0.05
Control / Контрольная ($n = 19$)	1.15 (1.5–1.0)	1.0 (1.3–0.8)	22	37	<0.01

Table 5 / Таблица 5

Average values of the number of episodes of involuntary contractions of the masticatory muscles at night in the gymnasts of the experimental group before and after a 10-day course of whole-body cryotherapy relative to the control group of gymnasts

Средние значения числа эпизодов непроизвольных сокращений жевательных мышц ночью у гимнасток экспериментальной группы до и после 10-дневного курса общей воздушной криотерапии относительно контрольной группы гимнасток

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 2 / 2-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	32.6 (140–0)	23.3 (110–0)	16	55	<0.01
Control / Контрольная ($n = 19$)	40.1 (135–0)	38.5 (140–0)	67	37	>0.05

At the end of the academic and training year, the experimental group showed an insignificant decrease in IRI in four athletes. No significant ABR dynamics was found relative to the first examination in the experimental group (Table 4). However, at the third examination in the control group, a decrease in the IRI relative to the first examination was recorded in 16 gymnasts. The empirical T was in the zone of significance with $T_{\text{emp}} < T_{\text{cr}}$ (0.01) (Table 4), and a significant decrease in IRI in the control group can be considered caused by the survey results at the end of the academic and training year. This confirms the data of other researchers on the decrease in the IRI under the influence of stress [10].

The number of involuntary contractions of the masticatory muscles at night in the experimental group significantly decreased after one WBAC course. The empirical T obtained was in the zone of significance with $T_{\text{emp}} < T_{\text{cr}}$ (0.01) (Table 5). In the control group, no decrease was observed in the frequency of involuntary contractions of the masticatory muscles at night on average $T_{\text{emp}} > T_{\text{cr}}$ (Table 5).

The examination at the end of the academic and training years revealed a further decrease in the number of involuntary contractions of the masticatory muscles at night. Empirical T was in the zone of significance with $T_{\text{emp}} < T_{\text{cr}}$ (0.01). In the control group, the average number of involuntary contrac-

Table 6 / Таблица 6

Average values of the number of episodes of involuntary contractions of the masticatory muscles at night at the beginning and the end of the academic-training year in the gymnasts of the experimental group who underwent whole-body cryotherapy courses and gymnasts of the control group

Средние значения числа эпизодов непроизвольных сокращений жевательных мышц ночью в начале и конце учебно-тренировочного года у гимнасток экспериментальной группы, проходивших курсы общей воздушной криотерапии, и гимнасток контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R_t$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 3 / 3-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	32.6 (140–0)	21.3 (108–0)	24	55	<0.01
Control / Контрольная ($n = 19$)	40.1 (135–0)	50.4 (130–0)	11.5	37	<0.01

Table 7 / Таблица 7

Average values of the “psychological component of health” according to SF-36 in the gymnasts of the experimental group before and after a 10-day course of whole-body cryotherapy relative to the gymnasts of the control group

Средние значения показателя «психологический компонент здоровья» по SF-36 у гимнасток экспериментальной группы до и после 10-дневного курса общей воздушной криотерапии относительно гимнасток контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R_t$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 2 / 2-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	73.7 (84–58)	78.8 (88–69)	12	55	<0.01
Control / Контрольная ($n = 19$)	74.3 (84–61)	75.1 (82–65)	81	37	>0.05

tions of the masticatory muscles at night increased. Empirical T was in the zone of significance with $T_{\text{emp}} < T_{\text{cr}}$ (0.01) (Table 6).

Thus, by reducing the number of involuntary contractions of the masticatory muscles at night, the positive effect of WBAC courses on the emotional state of gymnasts and an increase in their stress resistance was confirmed. At the end of the year, based on this indicator, an unstable psychoemotional state was diagnosed in the control group.

When polling gymnasts, even one WBAC course improved the psychoemotional state, as the majority of the gymnasts (82%) noted an improvement in mood, a feeling of freshness, and easiness after the first visit to the cryosauna.

To diagnose psychoemotional overstrain, a non-specific questionnaire for assessing the quality of

life (i.e., SF-36) was used. Based on the responses of the athletes, the “psychological component of health” (mental health) was determined, including average scores on the mental health, role functioning due to the emotional state, social functioning, and vitality scales.

After one WBAC course, an insignificant decrease in the psychological component of health according to SF-36 was noted in two gymnasts. Empirical T was in the zone of significance $T_{\text{emp}} < T_{\text{cr}}$ (0.01) (Table 7), which indicates an increase in the psychological component of health in the quality of life questionnaire. At the same time, among the athletes of the control group, no significant change was found in the psychological component of health during these 10 days, $T_{\text{emp}} > T_{\text{cr}}$ (Table 7). This confirms that the cryotherapy procedure had

Table 8 / Таблица 8

Average values of the “psychological component of health” according to SF-36 at the beginning and the end of the training year in gymnasts of the experimental group who underwent courses of whole-body cryotherapy and gymnasts of the control group

Средние значения показателя «психологический компонент здоровья» по SF-36 в начале и конце учебно-тренировочного года у гимнасток экспериментальной группы, проходивших курсы общей воздушной криотерапии и гимнасток контрольной группы

Group / Группа	Albumin binding reserve, % / Резерв связывания альбуминов, %		$T_{\text{emp}} / T_{\text{эмп}}$ ($\sum R$)	$T_{\text{cr}} / T_{\text{кр}}$ ($p \leq 0.01$)	p
	examination 1 / 1-е обследование M (max–min)	examination 3 / 3-е обследование M (max–min)			
Experimental / Экспериментальная ($n = 22$)	73.7 (84–58)	77.0 (83–60)	31.5	55	<0.01
Control / Контрольная ($n = 19$)	74.3 (84–61)	68.7 (80–55)	16	32	<0.01

a positive effect on the psychoemotional state of the gymnasts.

The questionnaire survey, conducted at the end of the academic and training years, showed that the psychological component of health increased significantly relative to the first survey in the experimental group but decreased in the control group (Table 8).

Thus, the positive influence of WBAC on psychological indicators of self-assessment of the quality of life, such as vitality, social functioning, influences of the emotional state on role functioning, and assessment of mental health, has been established. Moreover, a positive effect was established after the first WBAC course.

CONCLUSIONS

The study results revealed that an increase in stress resistance and a decrease in psychoemotional stress during the WBAC procedure in gymnasts manifested itself as an increase in the binding capacity of serum albumin, IRI stabilization, a decrease in the number of involuntary contractions of the masticatory muscles at night, and an increase in the “psychological component of health” according to the SF-36.

In this regard, the use of WBAC can be recommended for gymnasts in the preparatory and recovery periods of annual training cycle to increase stress resistance and prevent psychoemotional overstrain.

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