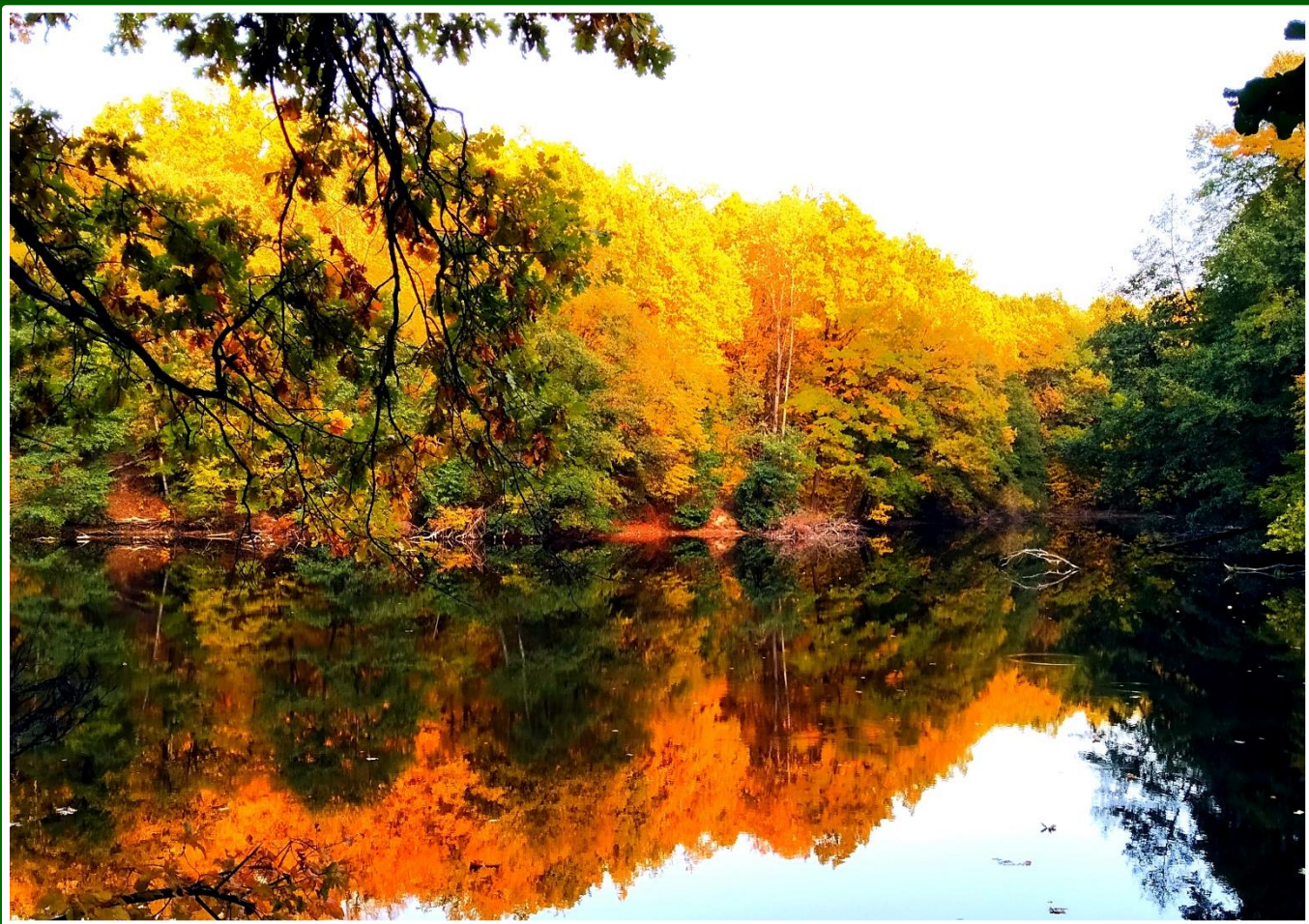




ISSN 2520-2677 (P) 2520-2685 (E)

2019
(5)3

**ЗДОРОВ'Я,
СПОРТ,
РЕАБІЛІТАЦІЯ**



Науковий журнал

**з проблем фізичного виховання, спорту,
фізичної терапії та реабілітації**

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IndexCopernicus

ICV 2018 = 100,00

DOI

<https://doi.org/10.34142/HSR.2019.05.03>

Health, sport, rehabilitation

Здоровье, спорт, реабилитация

Здоров'я, спорт, реабілітація

Key title: Zdorov'â, sport, reabilitaciâ

Abbreviated key title: Zdor. sport reabil.

ISSN 2520-2677 (Print)

ISSN 2520-2685 (Online)

<http://sportscience.org/index.php/health/index>

According to the order of the Ministry of Education and Science of Ukraine No. 326 of 04.04.2018, the journal is included in the **List of scientific professional editions** of Ukraine in which the results of dissertation papers for obtaining the degrees of the doctor and candidate of sciences may be published from: **physical education and sport; pedagogy**. According to the Order of the Ministry of Education and Science of Ukraine dated 07/16/2018 No. 775, the magazine is included in the **group B of professional editions** of Ukraine. Specialties: physical education and sports (24.00.01, 24.00.02, 24.00.03); pedagogical sciences (13.00.02 (physical culture, basics of health), specialty with new ciphers: 017 physical culture and sports, 011, 014.

Founder:

H.S. Skovoroda Kharkiv National Pedagogical University

Certificate of state registration:

KV № 22450-12350P dated 01.12.2016

Professional scientific publication on problems of physical education, sports, formation of a healthy way of life, rehabilitation, physical therapy.

Foundation year: 2015

Branch and problems: sport, physical education, training of movements, technology of physical education, physical therapy, rehabilitation, sports medicine

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Open AIRE

https://www.openaire.eu/search/publication?articleId=od_____2659::f35a4b41b5be9c3321005866090fdd8

Frequency: 4 times a year

Address of the editorial office: 61168, Kharkiv, ul. Valentinovskaya, 2, cab. 106th

Phone: +380664813666

E-mail: zhanneta.kozina@gmail.com

<http://sportscience.org/index.php/health/index>



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Justification of the effectiveness of the technique of myofascial self-massage using tennis balls in fitness

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DOI: <https://doi.org/10.34142/HSR.2019.05.03.06>

Abstract

Purpose: experimental substantiation of the effectiveness of myofascial self-massage techniques using tennis balls in fitness.

Material and Methods. The study involved 20 girls aged 20-25 years, engaged in fitness 3 times a week in the evening in the same group. The control and experimental groups trained on identical programs during October 2018 - March 2019. The difference was that after training, participants in the experimental group, under the guidance of a methodologist, performed myofascial self-massage of the muscles of the back surface of the body. The following tests were used: Questionnaire on the Borg scale, method for measuring flexibility, method for changing the height of the jump, methods for determining the number of jumps, functional test Shange. Inter-group differences were determined by tests.

Results. The application of this technique gave a significant ($p < 0.05$) improvement in flexibility indicators in the experimental group by 2.49 times. While in the control group, this indicator improved by 1, 59 times. Also in the experimental group, jumping indicators improved, namely the jump height by 28% of the initial indicators and the number of jumps by 12.6%. Based on the questionnaire data, the subjects of the experimental group improved sleep quality and tolerance of power loads.

Conclusion. The use of myofascial self-massage using tennis balls is a unique, affordable and effective way to improve physical performance. The results obtained indicate the positive impact of this technique and the appropriateness of its application in the process of training an athlete to optimize the functional state, improve flexibility and jumping ability.

Key words: myofascial self-massage; fitness; tennis ball; jumping ability; flexibility.

Анотація

Ковальова О.О., Ковальов В.В. Обґрунтування ефективності методики міофасціального самомасажу з використанням тенісних м'ячів в фітнесі.

Мета: експериментальне обґрунтування ефективності методики міофасціального самомасажу з використанням тенісних м'ячів в фітнесі.

Матеріал і методи. У дослідженні взяли участь 20 дівчат у віці 20-25 років, що займаються фітнесом силової спрямованості 3 рази на тиждень у вечірній час в одній групі. Контрольна і експериментальна групи тренувалися по ідентичним програм на протязі жовтень 2018 - березень 2019 року. Різниця полягала в тому, що після тренування учасниці експериментальної групи, під керівництвом методиста, виконували міофасціальний самомасаж м'язів задньої поверхні тіла. Застосовувалися наступні тести: Анкетування за шкалою Борґа, метод вимірювання гнучкості, метод зміни висоти стрибка, методи визначення кількості стрибків, функціональна проба Штанґе. Визначалися міжгрупові відмінності по проведеним тестам.

Результати. Застосування даної методики дало достовірне ($p < 0,05$) поліпшення показників гнучкості в експериментальній групі в 2,49 рази. У той час як в контрольній групі це показник покращився в 1, 59 разів. Так само в експериментальній групі покращилися показники стрибучості, а саме висота стрибка на 28% від початкових показників і кількість стрибків на 12,6%. Виходячи з даних анкетування у піддослідних експериментальної групи покращилася якість сну, і переносимість силових навантажень.

Висновки. Застосування міофасціального самомасажу з використанням тенісних м'ячів є унікальним, доступним і ефективним способом поліпшення фізичних показників. Отримані результати свідчать про позитивний вплив даної методики та доцільності її застосування в процесі тренувальної діяльності спортсмена для оптимізації функціонального стану, поліпшення гнучкості і стрибучості.

Ключові слова: міофасціальний самомасаж; фітнес; тенісний м'яч; стрибучість; гнучкість.

Аннотация

Ковалёва Е.А., Ковалёв В.В. Обоснование эффективности методики миофасциального самомассажа с использованием теннисных мячей в фитнесе.

Цель: экспериментальное обоснование эффективности методики миофасциального самомассажа с использованием теннисных мячей в фитнесе.

Материал и методы. В исследовании приняли участие 20 девушек в возрасте 20-25 лет, занимающихся фитнесом силовой направленности 3 раза в неделю в вечернее время в одной группе. Контрольная и экспериментальная группы тренировались по идентичным программам в течение октября 2018 - март 2019 года. Разница заключалась в том, что после тренировки участницы экспериментальной группы, под руководством методиста, выполняли миофасциальный самомассаж мышц задней поверхности тела. Применялись следующие тесты: Анкетирование по шкале Борґа, метод измерения гибкости, метод изменения высоты прыжка, методы определения количества прыжков, функциональная проба Штанґе. Определялись межгрупповые различия по проведенным тестам.

Результаты. Применение данной методики дало достоверное ($p < 0,05$) улучшение показателей гибкости в экспериментальной группе в 2,49 раза. В то время как в контрольной группе это показатель улучшился в 1, 59 раз. Так же в экспериментальной группе улучшились показатели прыгучести, а именно высота прыжка на 28 % от изначальных показателей и количество прыжков на 12,6 %. Исходя из данных анкетирования у испытуемых экспериментальной группы улучшилось качество сна, и переносимость силовых нагрузок.

Выводы. Применения миофасциального самомассажа с использованием теннисных мячей является уникальным, доступным и эффективным способом улучшения физических показателей. Полученные результаты свидетельствуют об положительном влиянии данной методики и целесообразности ее применения в процессе тренировочной деятельности спортсмена для оптимизации функционального состояния, улучшения гибкости и прыгучести.

Ключевые слова: миофасциальный самомассаж; фитнес; теннисный мяч; прыгучесть; гибкость.



Introduction

The modern world of physical culture is developing dynamically. New directions, equipment and techniques in fitness and sports appear in connection with the growing demands of society [1]. The main component of the training process should remain the quality of sports loads and safety for health [2, 3, 4, 5].

Flexibility is characterized by the mobility of the musculoskeletal system and contributes to the performance of movements with large amplitude, insufficient flexibility can lead to injuries / harm to health [6, 7, 8, 9]. Flexibility is one of the most important parameters and therefore its improvement occupies a leading position in the field of physical education.

Fascia is a connective tissue sheath covering organs, blood vessels, nerves and forming cases for muscles. As we move, the fascia rebuilds itself with layers of tissue that slide over each other and, at the same time, with a fibrous tissue structure that aligns to ultimately be able to change shape. Problems begin after the fascia is damaged. Injury often causes the formation of scar tissue, which in turn can bind the layers of tissue together. This can cause trigger points to form.

A trigger point is a hyper-irritable area in a tight band of skeletal muscles, painful when pressed, and causes characteristic (trigger) pain. Trigger points can be eliminated using non-invasive measures, such as the use of external NSAIDs, stretch marks, percutaneous electrical stimulation, physiotherapy and massage [10, 11]. TTs are directly related to myofascial and visceral pain. Brief intense stimulation of trigger points often leads to long-term pain relief [12, 13, 14].

Properly acting on muscles and fascia, it is possible to achieve a significant improvement in their condition in a short time and have a positive effect on internal organs in the long term [15].

The relationship of muscle elasticity, the ability to stretch painlessly and cramps is found in many scientific papers. Accordingly, cramps in stiff muscles are much more common, the reason for this may be the presence of trigger points that form in an overloaded muscle blocking its functions, and thereby worsening its extensibility. This contributes to a more frequent and intense onset of seizures both at night and during training [16, 17].

A healthy and elastic muscle makes it possible to stretch better, reduce trauma, and improve the quality of exercise and the general condition of the body after training [18, 19, 20]. While stiffness, tightness, and overtraining lead to the formation of trigger points, cramps, and a deterioration in the

flexibility and quality of classes in general [21, 22, 23]. The load on the muscles, in this case, will inevitably lead to injury, and further continued stretching will lead to their micro-fractures. After each such microtrauma, part of the muscle fibers and fascia heal, which entails a loss of qualities of the muscle itself - its elasticity, endurance, performance and strength, [10, 11, 17].

Such a massage method as self-massage is the most convenient for athletes, due to the lack of the possibility of using the services of massage therapists after each training. Using self-massage, an athlete will be able to relieve physical and even psycho-emotional stress on their own [24, 25, 26].

Recently, such a direction of massage as myofascial release is gaining popularity in fitness. Myofascial release is a soft manual technique for influencing fascia and muscles to relax, remove muscle clamps and work out trigger points. Myofascial release is indispensable if you want to speed up the recovery process after training, remove pain in the muscles, increase flexibility, increase the range of motion and reduce the likelihood of injuries, eliminate the resulting muscle hypertonicity. The myofascial release technique was invented by Anthony Chila, Carol Manheim, and John Peckham in 1981 [27, 28, 29]. The effect is achieved due to squeezing and passive stretching of muscles and fasciae, a change in the state of one fascia has a direct effect on the condition of others [12]. In fitness, myofascial release is mainly used for special rolls, but they are rather cumbersome, not convenient to transport and have a high cost, so we studied the possibility of replacing them with tennis balls as a more appropriate alternative.

Despite the popularity of the use of the myofascial release method, an analysis of the scientific literature has shown a small number of experimental studies in this direction.

Given the above, conducting experimental research on the use of the self-massage method using tennis balls after physical exertion is relevant and reasonable.

The purpose: development of self-massage techniques based on myofascial release using tennis balls and substantiation of the effectiveness of its use as a supplement to sports training.

Material and methods

Participants

The study involved 20 girls aged 20-25 years, engaged in fitness 3 times a week in the evening. Participants were randomly divided into



control (10 people) and experimental (10 people) groups. Both groups trained on identical programs from October 2018 to March 2019.

Flexibility Method

The measurement of the level of flexibility was carried out as follows: the participants assumed the initial position sitting on the floor with their legs straight in front of them, their backs straight, their arms raised above their heads so as to form a line with their backs. The body was tilted forward. The distance from the tips of the fingers to the tips of the toes was measured. Of 2 attempts, the best result was recorded.

Jumping Method

Participants standing against the wall holding chalk in a raised hand made a mark on the wall (starting indicator). Then two high jumps were performed without bending the legs in the knee joints and a chalk mark was made at the highest point on the wall (final indicator). To determine the height of the jump, the distance from the starting indicator to the final indicator was measured. Of the two results, the best was recorded. The number of jumps per 1 minute was also calculated to determine the influence of the developed methodology not only on the qualitative, but also on the quantitative indicators.

Sample Stange

The Stange test allows you to judge the oxygen supply of the body and characterizes the general level of fitness of the body. Before the main test, you need to measure the heart rate for 30 seconds in a standing position. Then, in a sitting position, you need to hold your breath in full breath, after making three breaths in 3/4 of the lung volume. It is recommended to wear a special clip on the nose or just hold it with your fingers. The breath holding time is fixed by a stopwatch. Immediately after resuming breathing, the pulse is detected again within 30 seconds. Evaluation Criteria: If the delay time is less than 39 seconds, then the result is considered unsatisfactory. A result within 40 - 49 seconds indicates a satisfactory rate, and a time of over 50 seconds is an excellent result.

Method for determining the quality of sleep on the Borg scale

To determine the quality of sleep, a survey was conducted using a modified Borg scale. The subjects were asked to choose an option that matches

their current state. Values from 6 to 20 were used where:

6-8 beautiful sleep easy falling asleep

9-12 good sleep long falling asleep

13-16 bad sleep frequent awakenings

17-20 poor sleep, cramps and morning

fatigue

Method for determining fatigue during exercise

To determine the feeling of fatigue during training, a survey was conducted using a modified Borg scale. Participants were asked to choose the option appropriate to their current state. Values from 6 to 20 were used where:

6-8 easy

9-12 little hard

13-16 hard

17-20 very hard

Research organization

The control and experimental groups were engaged in identical programs, namely, power-oriented fitness. The difference was that the participants in the experimental group were trained in self-massage using tennis balls, and did this massage, under the supervision of a coach, at the end of each training session. The muscles of the back surface of the body, namely the muscles of the lower leg, the muscles of the back of the thigh and the muscles of the back, were subjected to massage.

The technique of myofascial self-massage with the use of tennis balls is the starting position: sitting on the karimat, one leg is flat, the other bent at the knee is on the floor, hands are resting in the back, palms are turned inward. Under the shin of a flat leg put a tennis ball. Raise the pelvis, distributing body weight between the arms and smooth leg. Perform circular, horizontal and vertical movements of the foot on the ball, controlling the load due to the distribution of body weight between arms and legs. Then, without changing their position, they put the ball under the thigh and massage the back of the thigh. The same thing is repeated with the other leg. Then they are lowered to the back. Lying on their backs, they bend both legs at the knee and hip joints, the feet rest on the floor, take the second ball and put both balls under the back along the spinal column, resting their backs on the balls, raise the pelvis and perform smooth up and down movements moving the balls parallel to the spine. When a pain point is found, hold the position for 10-15 seconds. The degree of depression on a 10-point scale is 7. The duration of self-massage is 15 minutes. During the massage you need to breathe slowly and deeply to promote relaxation.



Measurements and tests were carried out before application, and after 6 months of applying the self-massage technique using tennis balls in the experimental group. In the control group, measurements were taken at the beginning of the experiment and after 6 months.

Statistical processing of results

Mathematical processing of experimental data obtained during the study was performed using the Microsoft Excel program and the online resource <http://medstatistic.ru/calculators>. For each indicator, the arithmetic mean value (\bar{x}), standard deviation (σ), and arithmetic mean error (m) were determined. We assessed the significance of differences between the parameters of the initial and final results, as well

as between the control and experimental groups according to student t-test with the corresponding significance level (p). Differences were considered significant at significance level $p < 0,05$.

Results

The arithmetic mean (\bar{x}), initial and final results in each group were compared for the control and experimental groups. For convenience in interpreting the results, the differences \bar{x} the difference between the initial and final indicators in both groups are presented ($p < 0,05$). The results of changes in the level of flexibility after 6 months and their stat. processing are presented in table 1.

Table 1

Indicators of the level of flexibility in the control ($n = 10$) and experimental ($n = 10$) groups before and after the experiment

Indicators	Group	$\bar{x} \pm m / (\sigma)$ before the experiment (initial)	$\bar{x} \pm m / (\sigma)$ after the experiment (after 6 months)	t	p	$\bar{x} \pm m / (\sigma)$ differences in indicators before and after	t K/E	p K/E
Flexibility level (cm)	K	49,4±9,4 /(28,3)	31,1±7,3 /(21,2)	1,81	0,08	18,3±2,4 /(7,2)	2,2	0,04
	Э	50,6±10,2 /(30,7)	20,3±5,7 /(17,1)	2,58	0,01	30,3±4,9 /(14,9)		

Notes: K - control group; E - experimental group

In this experiment, the greater the value (\bar{x})± $m / (\sigma)$ of the difference in the indicators before and after, the better. This value indicates how many centimeters the distance from the tips of the fingers to the tips of the toes has decreased. And accordingly,

the smaller the value (\bar{x})± $m / (\sigma)$ after the experiment (6 months), the better the result, since this shows a decrease in the distance from the fingertips to the tips of the toes, which indicates an increase in flexibility. Indicators of changes in the level of flexibility after 6 months are graphically presented in Fig. 1.

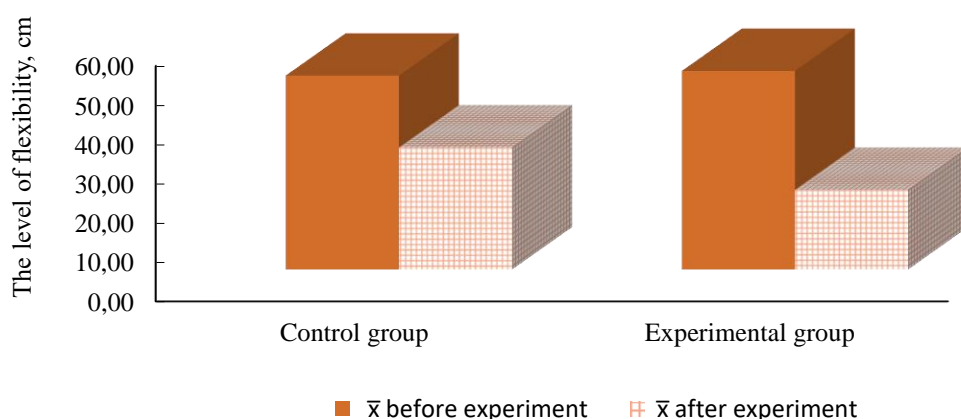


Fig 1. Results of measuring the level of flexibility (\bar{x})



A comparison of the results of the level of flexibility indicates that after 6 months the indicators in both groups improved significantly, which indicates the effectiveness of the training that took place during the experiment. Flexibility in the experimental group improved almost 2.5 times, while in the control group this indicator improved 1.6 times. This difference in results for a short period (6 months) proves the advantage of using the developed

self-massage technique using tennis balls, relative to the flexibility parameter.

The results of determining the height of the jump and their stat. processing are presented in table 2. The difference between the arithmetic mean values (\bar{x}) between the initial and final indicators of the control and experimental groups was compared, the value of Student t-test = 5.08 was calculated with the corresponding significance level ($p < 0.05$).

Table 2

Indicators of jumping height in the control (n = 10) and experimental (n = 10) groups before and after 6 months of the experiment

Indicators	Group	$\bar{x} \pm m / (\sigma)$ differences in indicators before and after	$\bar{x} \pm m / (\sigma)$ differences in indicators before and after	$\bar{x} \pm m / (\sigma)$ differences in indicators before and after	differenc (%)	t C/E	p C/E
Jump Height (cm)	C	13,2±0,8 /(2,6)	12,8±1,1 / (3,3)	-0.60±0.28 /(0,84)	-3%	5,08	0,00009
	E	12,1±1,0 /(3,1)	13,9±0,8 / (2,5)	1,8±0,38/ (1,14)	28%		

Notes: C - control group; E - experimental group

When determining the height of the jump, it was found that after the experiment in the control group, the results not only did not improve, but on the contrary worsened by 3%. Perhaps this is the effect of the fact that during strength training, the athletes of the control group strongly scored the lower leg muscles, thereby worsening the initial indicators. Or this phenomenon is due to the fact that with constant

force loads in the muscles trigger points arise, thereby blocking their normal functioning, giving a painful sensation in the muscles, tightness, fatigue and heaviness, which ultimately led to a decrease in the jumping height of the control group participants.

For clarity, presenting the results of the experiment, the initial indicators of changes in the height of the jump and after 6 months are presented in Fig. 2.

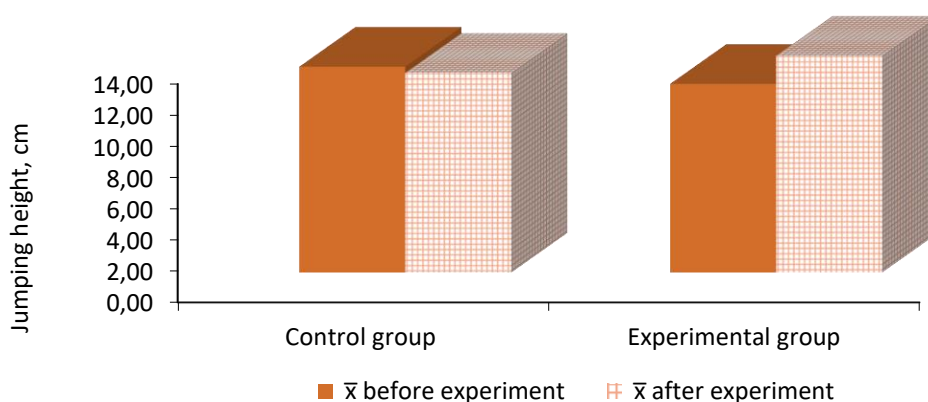


Fig. 2. Results of measuring the height of the jumps (\bar{x})

An increase in the performance of participants in the experimental group by 28% from the initial ones proves the positive impact of the

method of myofascial self-massage using tennis balls on the height of the jump in combination with strength training. Training makes muscles stronger,



and massage removes the effects of overtraining and positively affects their functionality.

The results of determining the number of jumps in 1 minute and their stat. processing are

presented in table. 3. The initial value of the arithmetic average number of jumps per minute and the result after 6 months of training in the control and experimental groups were compared.

Table 3

Indicators of the number of jumps in the control (n = 10) and experimental (n = 10) groups before and after the experiment

Indicators	Group	$\bar{x} \pm m$ before the experiment (initial)	σ	$\bar{x} \pm m$ after the experiment (after 6 months)	σ	t	p	t C/E	P C/E
Jumping (amount)	K	108 \pm 3,8	11,5	103,4 \pm 3,5	10,5	0,89	0,38	3,79	0,001
	Э	107,4 \pm 3,7	11,0	121 \pm 3,1	9,2	2,82	0,01		

Notes: C - control group; E - experimental group

An analysis of the results showed that the use of myofascial self-massage techniques using tennis balls after a power load gives a significant increase in the quantitative jumping index in the experimental group after 6 months, compared with the indicators

in the control group.

For clarity, the presentation of the experimental results, the initial indicators for determining the number of jumps and after 6 months are presented in Fig. 3.

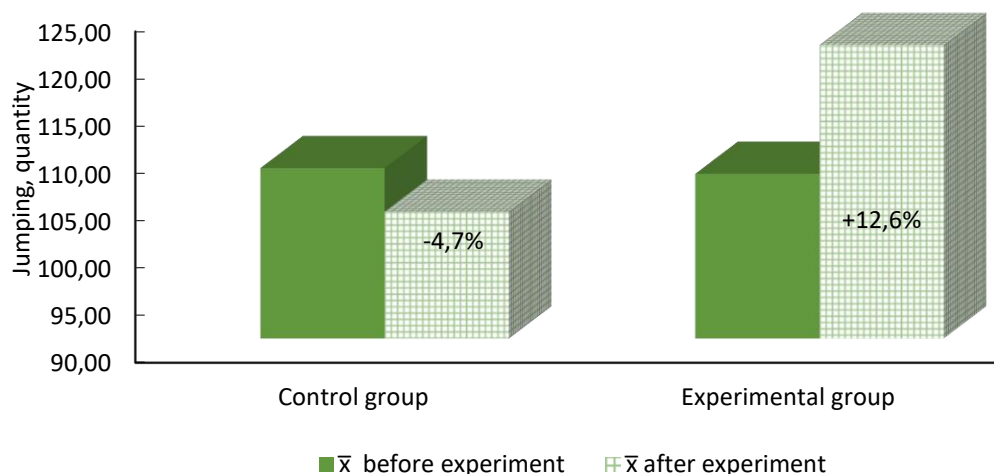


Fig. 3. The results of determining the number of jumps (\bar{x})

An analysis of the experimental results shows a slight decrease (4.7%) in the number of jumps per minute in the control group compared to the initial values, which correlates with the results of the height of the jumps. In the experimental group, an increase in the number of jumps by 12.6%

indicates a significant effect of the method of myofascial self-massage using tennis balls.

Results of the Stange test and their stat. processing are presented in table 4.



Table 4

Indicators of the Stange Sample in the control (n = 10) and experimental (n = 10) groups before and after the experiment

Indicators	Group	$\bar{x} \pm m$ before the experiment (initial)	σ	$\bar{x} \pm m$ after the experiment (after 6 months)	σ	difference s, %	t	p	t C/E	p C/E
Stange test (s)	C	42,3±2,8	8,5	47,1±2,4	7,2	11	1,3	0,21	0.13	0.9
	E	41±2,8	8,5	46,7±2,1	6,4	14	1,63	0,12		

Notes: C - control group; E - experimental group

Analysis of the results of the Stange test given in table 4, indicates that the overall level of fitness and oxygen supply to the body improved by 11% in the control and by 14% in the experimental group. There was no significant difference between the results of the control and experimental groups, which indicates a positive effect of the training process as a whole. But a slight increase (3%) in the experimental group suggests that with an increase in

the duration of the experiment and the zone of influence of self-massage, an improvement in the results of the Stange test will be observed in the longer term, this can serve as an aid for further studies.

The results obtained by questioning both groups on the Borg scale of sleep status are shown in Fig. 4.

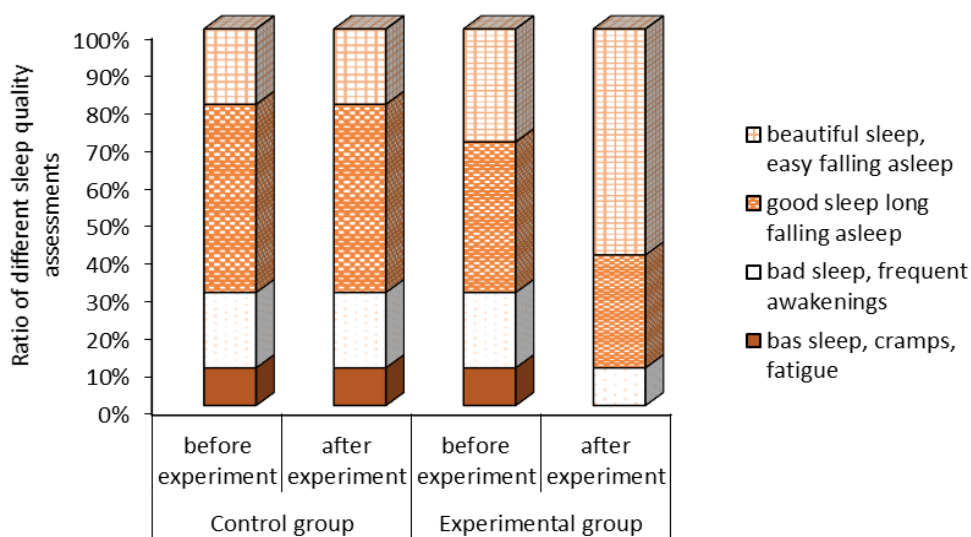


Fig. 4. Borg sleep state

The results obtained by questioning both groups on the Borg scale about pain in the muscles under power loads are shown in Fig. 5.

Processing the data of the experimental participants of both groups obtained during the questioning on the Borg scale showed that there were no changes in the control group, while in the experimental group the state of sleep improved slightly and the feeling of fatigue during training

decreased. Participants in the experimental group noted an improvement in sleep quality, reduction of night cramps and cramps during training. Training has become easier, and this directly affects the effectiveness and quality of training. Thus, we can conclude that the application of the method of myofascial self-massage using tennis balls has a positive effect not only on the muscles, but also on the body as a whole.

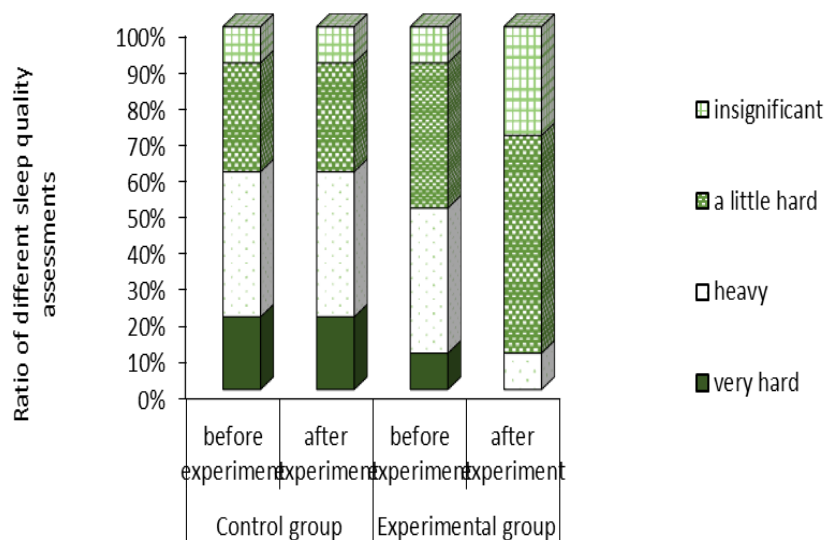


Fig. 5. Pain in the muscles with power loads according to the Borg scale

Discussion

The results of the study confirmed the data of scientists on the positive effects of massage on the athlete's body. The effectiveness of restorative massage has been proven by many researchers and experts in the field of sports and sports medicine. Massage helps to increase the range of motion, reduces muscle hypertonicity, improves ligamentous apparatus mobility and overall well-being. It increases the ability of muscles to move as quickly and accurately as possible, allows them to quickly relax and contract, reduces pain, increases recovery speed, avoids overstrain and fatigue from high intensity training loads [2,26,29].

The study showed that myofascial self-massage using tennis balls on the back of the body is an effective additional tool to improve the results of the training process. In the conditions of high requirements for athletes and great competition, any authorized tool or method that can improve results is just a godsend. Which once again emphasizes the significance of the experiment and the relevance of the developed methodology. Our proposed method involves self-massage. This massage option makes it possible to adjust, based on your sensations, the degree of pressure on the muscles and their stretching. The effect is achieved by squeezing and passive stretching, and a change in the state of one fascia has a direct effect on the condition of others [12].

The negative impact of overtraining is clearly reflected in the jumping test. Deterioration in the height and number of jumps may indicate the appearance of Trigger points that block the normal functioning of muscles, because they are formed in

the case of constant muscle tension, when muscle fibers are not able to relax [3,12]. While in the experimental group, the application of our technique allowed us to get rid of the trigger points and improved the jumping ability (height and number of jumps). The back muscles have three layers - two superficial, forming a silhouette and providing movement, and a deep layer - the muscles surrounding the spine, which have a protective function, structures of the spinal column. The study of the latter activates metabolic processes and helps to increase the protection of the spine from injuries. The shape and size of tennis balls is great for this purpose.

Given the foregoing, in the future it is planned to conduct studies aimed at identifying the effects of the developed methodology on the back muscles, posture and recovery systems of the body, to study in more detail the effect of myofascial self-massage using tennis balls on the strength indicators of the calf muscles

The results obtained during functional tests provide the basis for reflection and further study of the impact of the developed methodology on the athlete's body.

Currently, myofascial release penetrates deeper and deeper into fitness, and is widely used in various classes to relax and stretch muscles, as well as to improve overall well-being [31].

Conclusion

1. The use of myofascial self-massage using tennis balls is a unique, affordable and effective way to improve physical performance. The results obtained indicate the positive impact of this technique and the appropriateness of its application



in the process of training activity, in particular in fitness.

2. The developed technique helps to increase flexibility, increase the range of motion and, as a result, reduce the likelihood of injuries. This is evidenced by a significant increase ($p < 0.05$) of indicators of flexibility in the experimental group in relation to the control.

3. An analysis of the data obtained as a result of jumping tests indicates the effectiveness of the application of the developed methodology. So in the experimental group, the jumping performance increased significantly, in contrast to the control, in which these indicators, on the contrary, worsened in comparison with the initial indicators.

4. The application of the developed method did not significantly affect the results of the Stange test. The indicators improved both in the control and in the experimental groups and there is no significant difference between them.

5. Under the influence of massage, functional structural changes occur in the muscles and corresponding nerve centers of the brain. The developed technique plays a significant role in the fight against fatigue and increasing the effectiveness of training. So, practicing myofascial self-massage, participants in the experimental group improved sleep and sensations after power loads. Judging by the obtained Borg questionnaire data, most of the subjects began to sleep better, less likely to experience cramps and pain in the muscles, and also easier to tolerate power loads.

Conflict of interest

The authors declare that there is no conflict of interest.

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Received: 01.09.2019

Принята в редакцию 01.09.2019