

# Dynamics of change of high-speed and strengt preparedness of volleyball players under the influence of a set of exercises according to Tabata protocol

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## Abstract

**Purpose:** to determine changes in indicators of speed-strength abilities of volleyball players under the influence of a set of exercises according to the Tabata protocol.

**Material & Method:** 10 volleyball players of the male student team "KhSAPC", aged 17-21, took part in the pedagogical experiment, they have the first category in volleyball. The experiment lasted 2 months and consisted in using the Tabata protocol in the educational and training process of volleyball players. In the dynamics of the experiment, the speed-strength abilities of a selected group of volleyball players were tested. The assessment of the statistical reliability of the results of a comparative analysis of the indicators studied in this work was carried out using a nonparametric sign test.

**Results:** at the beginning of the pedagogical experiment, volleyball players had the following test results: push-ups for 20 s  $17,30 \pm 0,45$  times; standing long jump with push of two legs  $229,20 \pm 2,98$  cm; lifting the torso from the prone position in 30 s  $30,40 \pm 1,37$  times; throwing a stuffed ball weighing 1 kg from behind the head with two hands in a jump of  $11,20 \pm 0,93$  m; jump up from a place (according to V. M. Abalakov)  $49,60 \pm 2,51$  cm. After the pedagogical experiment, the values of indicators of the speed-strength abilities of volleyball players for each of the five tests turned out to be significantly higher compared to the results of the corresponding tests obtained before the start of the experiment.

**Conclusions:** the proposed sets of exercises according to the Tabata protocol turned out to be effective, as they made it possible to significantly improve ( $p > 0.01$ ) the speed-strength abilities of volleyball players in all tests. The results obtained allow us to recommend the use of exercise complexes according to the Tabata protocol for the training activity of volleyball players.

## Анотація

Аліна Мельник, Єжи Скробецький, Тамара Ляхова, Наталія Пащенко, Сергій Лебедев. Динаміка зміни показників швидкісно-силових здібностей волейболістів під впливом комплексу вправ за протоколом Табата. **Мета:** визначити зміни показників швидкісно-силових здібностей волейболістів під впливом комплексу вправ за протоколом Табата. **Матеріал і методи:** в педагогічному експерименті приймали участь 10 волейболістів чоловічої студентської команди «ХДАФК», віком 17-21 років, мають перший розряд з волейболу. Експеримент тривав 2 місяці та полягав у використанні протоколу Табата у навчально-тренувальному процесі волейболістів. В динаміці експерименту проведено тестування швидкісно-силових здібностей обраної групи волейболістів. Оцінка статистичної достовірності результатів порівняльного аналізу показників, які досліджувалися у даній роботі, проводилась за допомогою непараметричного критерію знаків. **Результати:** на початку педагогічного експерименту волейболісти мали наступні результати виконання тестів: згинання і розгинання рук в упорі лежачи за 20 с  $17,30 \pm 0,45$  разів; стрибок в довжину з місця поштовхом двох ніг  $229,20 \pm 2,98$  см; підйом тулуба із положення лежачи за 30 с  $30,40 \pm 1,37$  разів; кидок набивного м'яча вагою 1 кг із-за голови двома руками у стрибку  $11,20 \pm 0,93$  м; стрибок угору з місця (за В. М. Абалаковим)  $49,60 \pm 2,51$  см. Після проведення педагогічного експерименту значення показників швидкісно-

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### Key words:

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### Ключові слова:

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цикл  
серія

силових здібностей волейболістів по кожному з п'яти тестів виявилися значно вищими у порівнянні з результатами відповідних тестів отриманих до початку експерименту. **Висновки:** запропоновані комплекси вправ за протоколом Табата виявилися ефективними, так як дали змогу достовірно покращити ( $p > 0,01$ ) швидкісно-силові здібності волейболістів за всіма проведеними тестами. Отримані результати дають нам змогу рекомендувати використання комплексів вправ за протоколом Табата тренувальній діяльності волейболістів.

## Introduction

In modern volleyball, in connection with the expansion of the arsenal of technical and tactical actions of players, an increase in the intensity of the game, the speed of flight and the trajectory of the ball when performing the relevant technical elements, perfect physical preparedness of athletes is of particular importance. Therefore, the assessment of the level of special physical training of volleyball players is a significant scientific problem, where the main attention is paid to the development of speed-strength qualities of players (Borysova et al., 2018).

The implementation of most of the technical and tactical elements of volleyball, such as serving, attack hit, block, requires accuracy and purposefulness of movements, as well as the manifestation of explosive strength. Therefore, the physical training of a volleyball player should be aimed at developing the athlete's speed-strength abilities. Speed-strength abilities of volleyball players are determined by a complex of functional properties of the organism, which ensure the performance of motor actions in the minimum possible period of time (Kudriashov, 2002; Shvai et al., 2016; Kostyukevich et al., 2017; Hrynchenko et al., 2019).

One of the promising directions for solving the problem of increasing the efficiency of the training process of team sports athletes can be the use of the Izumi Tabata technique in physical training. Tabata is a high intensity interval training. It can include dynamic exercises in different sports, and the load should be sharp and explosive. (Kokareva & Kokarev, 2016; Kokareva, 2017.).

So, the authors of Kokareva & Kokarev (2016) experimentally proved the high efficiency of the Tabata technique using TRX-training exercises in the process of physical training of futsal players. The results of testing the indicators of physical fitness of the football players of the experimental group significantly improved ( $p < 0,001$ ,  $p < 0,05$ ). The results of the 30-meter run (increase by almost 1,20 s,  $p < 0,001$ ) and throwing the ball 2 kg with two hands from behind the head from the initial sitting position (increase by 200,50 cm,  $p < 0,001$ ) increased especially significantly.

The analysis of literary sources showed that the search for effective means and methods, as well as the introduction of new specialized training programs to improve the speed-strength abilities of volleyball players, will optimize their training process, which is an urgent problem today. Therefore, we decided to test the effectiveness of exercise complexes according to the Tabata protocol for improving the speed-strength preparedness of volleyball players of the "KhSAPC" student team.

### **Connection of work with scientific plans, themes.**

The study was carried out in accordance with the initiative theme of the Department of Sports and Outdoor Games of the KhSAPC "Improvement of the educational and training

process in sports games." State registration number of research and development: 0119U101644 (2019-2023).

**Purpose of the work:** to determine the changes in the indicators of speed-strength abilities of volleyball players under the influence of a set of exercises according to the Tabata protocol.

## Material and Methods of the research

### *Participants*

10 volleyball players aged 17-21 years old took part in the pedagogical experiment, the average age was  $18,9 \pm 1,19$ . They are players of the male student team "KhSAPC", the level of sportsmanship is the first category in volleyball.

### *Methods*

At the beginning of the study for the pedagogical experiment, we conducted a test to determine the initial indicators of the development of speed-strength abilities of the selected group of volleyball players. Repeated testing made it possible to determine these indicators after the pedagogical experiment. The following tests were carried out in the experiment: push-ups for 20 s, the number of times; long jump from a place with a push of two legs, cm; lifting the torso from a prone position in 30 s, number of times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump, m; jump up from a place (according to V. M. Abalakov), cm.

### *Procedure*

The pedagogical experiment lasted two months, was carried out in order to establish the effectiveness of the use of the proposed sets of exercises in the educational and training process of volleyball players. Complexes of exercises of speed-strength orientation according to the Tabata protocol were used. Tabata protocol is the principle of building interval training. It consists of a series of short 30-second intervals: 20 seconds of maximum effort and 10 seconds of rest. One Tabata cycle is eight such repetitions performed for 4 minutes. Volleyball players performed two cycles of 4 minutes, the break between cycles was 2 minutes. An obligatory methodological condition was the performance of each repetition with the highest possible result, that is, the level of tension in the performance of subsequent repetitions is close to the first result. It was proposed to use two sets of exercises alternately, in each other training. Volleyball players alternately used these sets of exercises twice a week in a specially preparatory part of the training session for two months. Each complex consisted of eight different exercises.

During the study, the rights of athletes were taken into account in accordance with the requirements of the Helsinki Convention. All participants gave informed consent to participate in the study.

### *Statistical analysis*

Statistical analysis was performed using licensed MS Excel. The indicators of descriptive statistics were determined: arithmetic mean and standard deviation. The statistical significance of the results of a comparative analysis of the indicators studied in this work was assessed using a nonparametric sign test (G).

## Results of the research

To identify the initial indicators of the development of speed-strength abilities of volleyball players of the «KhSAPC» student team, we used five tests and obtained the following

results of their implementation: flexion and extension of the arms in the lying position for 20 s  $17,30 \pm 0,45$  times; standing long jump with push of two legs  $229,20 \pm 2,98$  cm; lifting the torso from the prone position in 30 s  $30,40 \pm 1,37$  times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump of  $11,20 \pm 0,93$  m; jump up from a place (according to V. M. Abalakov)  $49,60 \pm 2,51$  cm. The athletes were given three attempts to complete each test, the best result was counted. After the initial testing, the complexes of speed-strength exercises proposed by us according to the Tabata protocol were introduced into the educational and training process of volleyball players. Volleyball players alternately used these sets of exercises twice a week in a specially preparatory part of the training session for two months. The complexes included such exercises as: burpees, Power Jacks, plank jumps, high hip running in place, jumping from two legs to the box, etc. The recommended sets of exercises are described in detail in the work Melnyk & Strelnykhova (2022).

After the pedagogical experiment, the level of development of the speed-strength abilities of volleyball players who participated in our study was re-tested and the corresponding results obtained are given in Table 1.

An assessment was made of the reliability of the difference between the average statistical values of the indicators of these tests, determined before and after the pedagogical experiment using a nonparametric sign test. Since the number of non-zero shifts  $G(0)=0$ , it can be used when comparing the test results of the same group of athletes over time. The results of a comparative analysis are presented in Table 1. Analysis of the results for all five tests showed that the number of improvements, deteriorations and lack thereof corresponds to:  $G(+)=10$ ,  $G(-)=0$ ,  $G(0)=0$ ,  $n=10$ . Hence, an improvement in test scores is typical. With reliability  $p \leq 0,01$ ,  $G_{cr}=0$ . Since  $G_{cr}$  does not exceed  $G(-)$ , this confirms the reliability of the increase in results and proves the effectiveness of using the proposed sets of exercises according to the Tabata protocol to improve the speed-strength abilities of volleyball players.

## Discussion

In the special physical training of team sports players, special attention should be paid to improving their speed-strength readiness, as this has a positive effect on the effectiveness of their competitive activities (Bykova et al., 2015; Horchaniuk et al., 2015; Shvai et al., 2016; Medvedieva

**Table 1**  
**Results of assessing the statistical significance of changes in the indicators of speed-strength abilities of volleyball players of the student team "KhSAPC" in a pedagogical experiment using the sign criterion G ( $n_1=10$  i  $n_2=10$ )**

| №<br>i/o | Definition of the test  | Before the<br>experiment | After the<br>experiment | G(+) | p           |
|----------|---|--------------------------|-------------------------|------|-------------|
|          |   | $\bar{X} \pm \sigma$     |                         |      |             |
| 1        | Push-ups for 20 s (number of times)   | $17,30 \pm 0,45$         | $18,50 \pm 0,34$        | 10   | $\leq 0,01$ |
| 2        | Standing long jump (cm)   | $229,20 \pm 2,98$        | $243,10 \pm 3,11$       | 10   | $\leq 0,01$ |
| 3        | Lifting the body from a prone position in 30 s (number of times)                        | $30,40 \pm 1,37$         | $33,20 \pm 2,48$        | 10   | $\leq 0,01$ |
| 4        | Throwing a stuffed ball weighing 1 kg from behind the head with two hands in a jump (m) | $11,20 \pm 0,93$         | $12,84 \pm 0,45$        | 10   | $\leq 0,01$ |
| 5        | Jump up from a place (cm)   | $49,60 \pm 2,51$         | $53,80 \pm 3,11$        | 10   | $\leq 0,01$ |

& Dorokhova, 2017; Paievskiy et al., 2018; Nesen & Pryimak, 2018; Petrov, 2019).

We share the opinion of Kostyukevich et al. (2017), Imas et al. (2018), Shlonskaya and Hammudi (2019), Mario Terol-Sanchis et al. (2021) that it is the improvement of speed-strength abilities that will allow volleyball players to effectively perform such techniques as a power serve in a jump, a block and an attack hit, which are carried out due to the speed of movements and the preservation of the kinematic structure in space and time. Based on this, we have chosen the purpose and direction of our research.

In the course of our study, we used a longitudinal method, with the help of which we found out the effectiveness of using the proposed sets of exercises according to the Tabata protocol in the training activities of volleyball players of the student team of the "KhSAPC" to improve their speed-strength abilities. Since the changes in test scores before and after the pedagogical experiment have significantly improved. The longitudinal research method was used in the works Rezaeimanesh & Amiri-Farsani (2011), Sheppard et al. (2011), Imas et al. (2018), Borysova et al. (2018), Hrynchenko et al. (2019), Shlonska & Khammudi (2019), Mario Terol-Sanchis et al. (2021).

When selecting tests to determine changes in the speed-

strength abilities of volleyball players, we relied on the studies of the authors Kudriashov (2002), Bishop (2003), Bykova et al. (2015), Karatnyk et al. (2016), Nesen & Pryimak (2018), Shevchenko et al. (2018) and Moshenska & Petrov (2020). Most of all, they preferred tests: a standing long jump with a push of two legs, a jump up from a place, a throw of a stuffed ball weighing 1 kg from behind the head with both hands from different initial positions.

Expanded and supplemented the results of research by Pashkevych et al. (2015), Kokareva & Kokarev (2016), Kokarev et al. (2017) and Kokareva (2017) on the use of exercise complexes according to the Tabata protocol in the educational and training process of athletes and students. Their effectiveness was confirmed by positive changes in testing indicators during the pedagogical experiment. Analysis of the scientific and methodological literature showed that not enough attention was paid to the use of Tabata in the training process of athletes in team sports.

During our research, we received an improvement in volleyball players' jumping performance, which is the main manifestation of the speed-strength abilities of volleyball players. This problem was solved Pushparajan (2010), Sheppard et al. (2011), Sattler et al. (2012) and Özkan, Çdmenli, et al. (2016).

## Conclusions

A consistent pedagogical experiment was carried out, aimed at increasing the level of speed-strength abilities of volleyball players of the student team «KhSAPC». At the beginning of the pedagogical experiment, volleyball players had the following test results: push-ups for 20 s 17,30±0,45 times; standing long jump with push of two legs 229,20±2,98 cm; lifting the torso from the prone position in 30 s 30.40±1.37 times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump of 11,20±0,93 m; jump up from a place (according to V. M. Abalakov) 49,60±2,51 cm. After the pedagogical experiment, the values of indicators of the speed-strength abilities of volleyball players for each of the five tests turned out to be significantly higher compared to the

results of the corresponding tests obtained before the start of the experiment.

The proposed sets of exercises according to the Tabata protocol turned out to be effective, as they made it possible to significantly improve ( $p>0,01$ ) the speed-strength abilities of volleyball players in all tests. The results obtained allow us to recommend the use of exercise complexes according to the Tabata protocol for the training activity of volleyball players.

**Prospects for further research.** The study of the influence of the increase in the indicators of the speed-strength abilities of the volleyball players of the student team of the «KhSAPC» on the quantitative indicators of the effectiveness of the performance of the power serve in the jump in their competitive activity.

## Author Contributions

Melnyk Alina: design / research planning, data collection / input, manuscript preparation, literature analysis; Jerzy Skrobecki: data analysis / statistics, data interpretation; Liakhova Tamara: analysis / search of literature, data collection, fundraising; Pashchenko Natalia: data collection, literature search, fundraising; Lebedev Sergey: statistics, analysis / search of literature, fundraising.

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## Conflicts of Interest

The authors declare no conflict of interest.

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