

# INFLUENCES OF HIGH-INTENSITY INTERVAL TRAINING ON PHYSICAL ABILITY IN VOLLEYBALL



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INFLUÊNCIAS DO TREINAMENTO INTERVALADO DE ALTA INTENSIDADE SOBRE A HABILIDADE FÍSICA DO VOLEIBOL

INFLUENCIAS DEL ENTRENAMIENTO POR INTERVALOS DE ALTA INTENSIDAD EN LA CAPACIDAD FÍSICA DEL VOLEIBOL

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## ABSTRACT

**Introduction:** Traditional physical training has a good effect on the improvement of strength and quality indicators of the athletes; however, recent pieces of evidence indicate that relating it to high-intensity interval training may reduce the physical problems of its practitioners, besides accelerating the physical skills required by volleyball. **Objective:** Study the application of high-intensity interval training on the physical ability of volleyball players. **Methods:** 40 volunteers were recruited, among freshmen and university students, practicing volleyball. They were divided equally into the control and experimental group. The control group used traditional physical training based on aerobic exercise, while the experimental group adopted a high-intensity interval training program. Each session lasted 1.5 hours, twice a week, for 9 weeks. Relevant physical and functional data were individually collected before and after the intervention, compared, and statistically analyzed. **Results:** There was an increase in the quality of the long-distance throw, horizontal pull force, 800 m run, 30 m run, cross jump, and repeated crossing experiment. **Conclusion:** The high-intensity interval training protocol raised the fitness level of volleyball players, allowing optimization of performance on the court. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** High-Intensity Interval Training; Volleyball; Physical Education and Training.

## RESUMO

**Introdução:** O treinamento físico tradicional apresenta um bom efeito na melhoria da força e dos indicadores de qualidade dos atletas, porém evidências recentes indicam que relacioná-lo ao treinamento intervalado de alta intensidade possa reduzir os problemas físicos de seus praticantes além de acelerar as habilidades físicas requeridas pelo voleibol. **Objetivo:** Estudar a aplicação do treinamento intervalado de alta intensidade sobre a habilidade física dos praticantes de voleibol. **Métodos:** Foram recrutados 40 voluntários entre calouros e alunos da universidade, praticantes de voleibol. Eles foram divididos igualmente em grupo controle e experimental. O grupo de controle utilizou o treinamento físico tradicional baseado em exercício aeróbico enquanto o experimental adotou o programa de treinamento intervalado de alta intensidade. Cada sessão durou 1,5 horas, duas vezes por semana, por 9 semanas. Os dados físicos e funcionais relevantes foram individualmente coletados antes e após a intervenção, comparados e analisados estatisticamente. **Resultados:** Houve um aumento na qualidade do arremesso de longa distância, força de tração horizontal, corrida de 800 m, corrida de 30 m, salto transversal e no experimento de cruzamento repetido. **Conclusão:** O protocolo de treinamento intervalado de alta intensidade elevou o nível de aptidão física nos jogadores de vôlei, permitindo uma otimização de desempenho na quadra. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Treinamento Intervalado de Alta Intensidade; Voleibol; Educação Física e Treinamento.

## RESUMEN

**Introducción:** El entrenamiento físico tradicional tiene un buen efecto en la mejora de los indicadores de fuerza y calidad de los atletas; sin embargo, recientes evidencias indican que relacionarlo con el entrenamiento interválico de alta intensidad puede reducir los problemas físicos de sus practicantes, además de acelerar las habilidades físicas requeridas por el voleibol. **Objetivo:** Estudiar la aplicación del entrenamiento interválico de alta intensidad sobre la capacidad física de los practicantes de voleibol. **Métodos:** Se reclutaron 40 voluntarios, entre estudiantes de primer año y universitarios, practicantes de voleibol. Se dividieron a partes iguales en grupo de control y grupo experimental. El grupo de control utilizó un entrenamiento físico tradicional basado en ejercicios aeróbicos, mientras que el grupo experimental adoptó un programa de entrenamiento interválico de alta intensidad. Cada sesión duró 1,5 horas, dos veces por semana durante 9 semanas. Se recogieron individualmente datos físicos y funcionales relevantes antes y después de la intervención, se compararon y se analizaron estadísticamente. **Resultados:** Hubo un aumento en la calidad del lanzamiento de larga distancia, la fuerza de tracción horizontal, la carrera de 800 m, la carrera de 30 m, el salto cruzado y en el experimento de cruce repetido. **Conclusión:** El protocolo de entrenamiento interválico de alta intensidad elevó el nivel de condición física en jugadores de voleibol, permitiendo una optimización del rendimiento en la cancha. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptorios:** Entrenamiento de Intervalos de Alta Intensidad; Voleibol; Educación y Entrenamiento Físico.



## INTRODUCTION

Volleyball is a very popular sport in the teaching of physical education in colleges and universities in China.<sup>1</sup> The students have a strong interest in participating in volleyball. In addition, volleyball has certain help for students' physical functions.<sup>2</sup> The development of volleyball courses in colleges and universities also has a certain scale. With the continuous improvement of sports science, high-intensity interval training has also been adopted by universities.<sup>3</sup> The introduction of this advanced training method into the curriculum will significantly improve the students' volleyball skills.<sup>1</sup> It has effectively improved the project performance of student groups, and the physical quality of students has been constantly enhanced.<sup>4</sup> Using the related teaching of high-intensity interval training to improve the physical problems of student groups is conducive to the development of volleyball in colleges and universities, and can enable student groups to obtain better curriculum experience.<sup>5</sup> In this paper, the application of high-intensity interval training in volleyball physical ability teaching is studied experimentally.

## METHOD

### Research objects

The article first used the literature research method, looked up and sorted out a large number of relevant materials, sorted out and analyzed the model design of high-intensity intermittent training, as well as the relevant content of volleyball and physical education, and obtained a certain theoretical basis. The study and all the participants were reviewed and approved by Ethics Committee of China JiLiang University (NO.2018CJLU065). Then, a controlled experiment was designed to select the subjects from the freshmen and sophomores of a university.

After fully informing the relevant needs, 40 subjects were recruited and divided into the experimental group and the control group according to the form of drawing lots. The basic information is shown in Table 1,  $P > 0.05$ , indicating that there is no significant difference affecting the experimental results.

### Experimental design

The experiment was conducted according to the model of control experiment, in which the control group used traditional volleyball physical training based on aerobic exercise. The experimental group adopted the intervention program of high-intensity interval training. After completing a group of training, they took the form of walking or sitting quietly for rest. In addition to different training contents, the experimental group and the control group maintained the same situation. The experiment was conducted in a pattern of 1.5 hours per training, twice a week, and lasting for 9 weeks. In order to ensure the preciseness of the experiment, the daily life, learning and training of the experimental group and the control group are basically the same, without additional training.

The strength, speed, coordination and jumping ability were selected in the judgment of physical fitness optimization. As the standard of volleyball physical strength improvement, in terms of strength, we chose two items: solid ball long throw and horizontal push; in terms of speed, we chose three items: 800m run, half "meter" movement and

**Table 1.** Experimental grouping.

| Basic indicators | Age (years)      | Height (cm)       | Weight (kg)      | Training years  |
|------------------|------------------|-------------------|------------------|-----------------|
| Experience group | 20.6132 ± 0.9453 | 176.9227 ± 4.2083 | 61.4943 ± 7.2970 | 4.9642 ± 0.6682 |
| Control group    | 20.0369 ± 0.9859 | 175.1268 ± 3.2420 | 64.1359 ± 4.8224 | 4.9223 ± 0.8436 |
| P                | 0.7099           | 0.0648            | 0.1068           | 0.8162          |

30m sprint; in terms of coordination, we chose two items: cross jump and repeated cross experiment; in terms of jump ability, we chose two items: rope jump and vertical jump to touch the height. These items can indirectly show the sports ability of volleyball players, It will also have a certain effect on the competitive level of the competition field.

## RESULTS

The physical fitness optimization of volleyball is closely related to the competitive level of volleyball. Therefore, in terms of selection indicators, some items that can not only represent the physical fitness optimization of volleyball, but also be truly applied in the volleyball arena are selected, which are divided into four aspects: strength, speed, coordination ability, jumping ability, etc. The specific optimization results are as follows:

Table 2 shows the impact of high-intensity interval training on strength indicators in physical fitness. In the aspect of solid ball throw, the throw distance of the experimental group was (10.8303 ± 0.2296) m before the experiment, and increased to (11.8995 ± 0.2181) m after the experiment,  $P = 0.0070 < 0.01$ ; In terms of horizontal pushing, the weight of the experimental group was (46.2703 ± 1.0469) kg before the experiment, and it was raised to (48.9310 ± 0.8335) kg after the experiment,  $P = 0.0041 < 0.01$ . It can be seen that the high-intensity interval training selected in this paper can improve the distance of solid ball throwing and increase the strength of horizontal push. However, the comparative analysis between the experimental group and the control group shows that the optimization of the relevant strength indicators in the experimental group is little different from that in the control group, which can only be said to be slightly optimized. Therefore, high-intensity interval training has certain advantages over traditional physical training methods, but it is not obvious.

After the start of the volleyball match, the players need to adjust their position according to the position of the ball, complete the pass of the ball and achieve the combination of tactics in the running process. Therefore, the faster the players run in the field, the faster they can achieve the predetermined goal in a shorter time and become more flexible in the whole court. Therefore, Table 3 selects long-distance 800m run, half meter word movement to show flexibility, and 30m sprint to show instantaneous speed as the judgment criteria to study the impact of high-intensity interval training on volleyball physical speed indicators. The results showed that in the 800m running, the time

**Table 2.** The influence of high-intensity interval training on physical strength index of volleyball.

| Index             | Long throw of solid ball |                  | Bench press      |                  |
|-------------------|--------------------------|------------------|------------------|------------------|
|                   | Experience group         | Control group    | Experience group | Control group    |
| Before experiment | 10.8303 ± 0.2296         | 10.9728 ± 0.0915 | 46.2703 ± 1.0469 | 46.2877 ± 1.0410 |
| After experiment  | 11.8995 ± 0.2181         | 11.0460 ± 0.1012 | 48.9310 ± 0.8335 | 48.1445 ± 1.0521 |
| P value           | 0.0070                   | 0.0203           | 0.0041           | 0.0425           |

**Table 3.** The influence of high-intensity interval training on the speed index of volleyball physical strength.

| Index             | 800m run         |                 | Half meter movement |                  | 30m Sprint       |                 |
|-------------------|------------------|-----------------|---------------------|------------------|------------------|-----------------|
|                   | Experience group | Control group   | Experience group    | Control group    | Experience group | Control group   |
| Before experiment | 3.0696 ± 0.3272  | 3.0847 ± 0.0202 | 17.4442 ± 0.5092    | 17.5132 ± 0.5176 | 4.4952 ± 0.1220  | 4.5454 ± 0.0919 |
| After experiment  | 2.5384 ± 0.0300  | 2.9953 ± 0.0305 | 17.0328 ± 0.0204    | 17.1831 ± 0.0304 | 4.2830 ± 0.0610  | 4.4098 ± 0.0892 |
| P value           | 0.0030           | 0.2907          | 0.0080              | 0.7502           | 0.0163           | 0.0415          |

of the experimental group was  $(3.0696 \pm 0.3272)$  minutes before the experiment, but it was shortened to  $(2.5384 \pm 0.0300)$  minutes after the experiment,  $P=0.0030 < 0.01$ ; In the aspect of half "meter" movement, the time of the experimental group was  $(17.4442 \pm 0.5092)$  seconds before the experiment, but shortened to  $(17.0328 \pm 0.0204)$  seconds after the experiment,  $P=0.0080 < 0.01$ ; In terms of 30 m sprint, the time of the experimental group was  $(4.4952 \pm 0.1220)$  seconds before the experiment and  $(4.2830 \pm 0.0610)$  seconds after the experiment,  $P=0.0163 < 0.05$ . This shows that the high-intensity interval training selected in this paper can shorten the exercise time and improve the speed index, and its optimization range of the physical speed index is better than the traditional volleyball physical training. However, due to the different pertinence of sports, the optimization of physical indicators is also biased. This optimization training mode has a significant effect on the improvement of 800m running. For half meter movement and 30m sprint, although it has also been optimized, it is still not significant.

Therefore, the coordination training of volleyball physical fitness is also a major focus of volleyball physical fitness training. Table 4 selected the cross jump and repeated crossing experiment as the judgment index. After 9 weeks of experiment, the time of the experimental group in the cross jump was  $(23.7212 \pm 1.8271)$  seconds before the experiment, and shortened to  $(26.5899 \pm 1.1600)$  seconds after the experiment,  $P=0.0030 < 0.01$ ; In terms of repeated spanning experiment, the number of times in the experimental group was  $(42.8002 \pm 2.1752)$  before the experiment, and increased to  $(45.0533 \pm 1.0673)$  after the experiment,  $P=0.0020 < 0.01$ . This shows that the high-intensity interval training selected in this paper has a stronger optimization effect on athletes' physical coordination than the traditional volleyball physical training, and the optimization range of the experimental group is significantly greater than the control group, indicating that the high-intensity interval training mode in this paper has a stronger advantage in physical coordination training.

In a volleyball match, the height of the ball is uncertain, so the stronger the jumping ability of the players, the more likely they are to catch the ball flying from a higher position, and the scope of service is wider, so they have more initiative in the volleyball court, control the progress of the whole game, and improve their own competitive level and performance. Therefore, the research on volleyball physical jump is also the most important part of the current volleyball physical optimization. Table 5 shows the influence of high-intensity interval training on volleyball physical jumping indexes. In terms of rope skipping, the number of the experimental group was  $(59.2284 \pm 1.0484)$  before the experiment, and increased to  $(62.8462 \pm 0.7436)$  after the experiment; The number of the control group was  $(59.0774 \pm 0.9961)$  before the experiment, and increased to  $(61.4597 \pm 1.4883)$  after the experiment. In the aspect of longitudinal jumping, the height of the experimental group was  $(2.7247 \pm 0.4777)$  m before the experiment, and it was raised to  $(2.8871 \pm 0.4472)$  m after the experiment; The height of the control group was  $(2.7863 \pm 0.2875)$  m before the experiment, and increased to  $(2.82745 \pm 0.2860)$  m after the experiment. Through the comparison within the group, we can see that high-intensity interval training and ordinary volleyball physical training can improve the jumping indicators of volleyball players. From the comparison between groups, it can be seen that the optimization effect of high-intensity interval training on volleyball physical jumping index is significantly higher than that of the control group, which shows that the high-intensity interval training selected in this paper is better than the traditional volleyball physical jumping ability training.

## DISCUSSION

With the scientific research, the training methods for sports are constantly improved. Intermittent training mode has gradually come

**Table 4.** The influence of high-intensity interval training on the coordination index of volleyball physical ability.

| Index             | Cross jump       |                  | Repeated straddle experiment |                  |
|-------------------|------------------|------------------|------------------------------|------------------|
|                   | Experience group | Control group    | Experience group             | Control group    |
| Before experiment | 23.7212 ± 1.8271 | 23.4632 ± 1.9007 | 42.8002 ± 2.1752             | 42.4752 ± 1.1996 |
| After experiment  | 26.5899 ± 1.1600 | 24.6779 ± 1.6199 | 45.0533 ± 1.0673             | 44.3303 ± 1.2870 |
| P value           | 0.0030           | 0.0254           | 0.0020                       | 0.0334           |

**Table 5.** The influence of high-intensity interval training on the jumping index of volleyball physical ability.

| Index             | Skipping rope    |                  | Jump up and touch the height |                  |
|-------------------|------------------|------------------|------------------------------|------------------|
|                   | Experience group | Control group    | Experience group             | Control group    |
| Before experiment | 59.2284 ± 1.0484 | 59.0774 ± 0.9961 | 2.7247 ± 0.4777              | 2.7863 ± 0.2875  |
| After experiment  | 62.8462 ± 0.7436 | 61.4597 ± 1.4883 | 2.8871 ± 0.4472              | 2.82745 ± 0.2860 |
| P value           | 0.0030           | 0.0417           | 0.0102                       | 0.2055           |

into people's view. High intensity interval training can burn more fat in a shorter training time, with high efficiency of training. This advanced training method is generally designed for athletes. However, with the progress of science, high-intensity interval training has gradually been introduced into college physical training and physical education curriculum teaching. The high-intensity interval training mode is more likely to make the human body feel tired than the conventional training mode. According to effective statistics, the time used for high-intensity interval training to generate fatigue is about one third of the training time of conventional training mode. Before the training session, necessary warm-up activities are required. Warm up activities can be carried out through some specific technical movements, and can also be assisted by conventional sports equipment. Such as bicycles, elliptical machines, treadmills and other sports equipment. The warm-up activity lasts about ten minutes. The function of warm-up exercise is to make the physical activity meet the exercise requirements. After the warm-up, necessary stretching activities should be coordinated. Through stretching activities, the ligaments and various soft tissues of the whole body can reach a certain flexibility. The teacher's exercise can also help the whole body's joint activity meet the exercise requirements. Because of the special scoring method of volleyball, it is often necessary to give volleyball a certain amount of strength, so that the ball speed can reach the goal of difficult and easy for the opponent to hit back accurately. The key factor of this kind of technical training is the explosive power of the player when hitting the ball. Training for explosive power. Most of them focus on anaerobic training. Improve your strength attributes by increasing your muscle mass. In daily training relief, upper limb strength training can be carried out through push ups, pull ups, etc. You can also use auxiliary equipment to cooperate with training, such as dumbbells, presses and other training equipment for targeted strength training. Usually, in the process of volleyball, a large number of jumping sports are needed to support the use of other technical movements. These jumping movements put forward higher requirements for waist and abdomen strength and hip muscle group. During training, the core strength of the waist and abdomen can be trained by means of sit ups, abdominals, side lying and leg lifting, jumping exercises, etc. Use barbell weights for squatting exercises or hip bridge exercises. It can effectively improve the strength attribute of hip and thigh muscle groups. The strength of the lower leg muscles and the ankle joint plays a decisive role in the height and speed of the jump. During the training, we can carry out targeted training on

calf muscle strength through various jumping training. All sequence methods can be interspersed with some aerobic training focusing on running. Through the combination of aerobic and anaerobic sequence, the training intensity is effectively improved. And in their own sports ability to reach a certain range, you can increase the training intensity by increasing the way of weight bearing.

## CONCLUSION

In the whole volleyball match, volleyball players need to constantly run and jump in the field according to the position of the ball and the tactical needs of the team, which is a very big consumption of physical strength. Therefore, in volleyball, whoever has stronger jumping ability, faster running speed and more coordinated physical quality can gain more initiative, master the rhythm of the match and win the match. In the relevant analysis of physical training, many

colleges and universities still use the traditional physical training model, represented by aerobic sports and track and field sports. These physical training have good effects on the improvement of athletes' strength and quality indicators, but the research on athletes' coordination and jumping ability is not enough. Therefore, according to the actual needs of volleyball, this paper constructs a high-intensity interval training mode, and discusses its role in volleyball physical training. The research results show that high-intensity interval training can better improve the physical fitness level of volleyball players, and has better optimization effect on physical coordination and jumping ability, which are closely related to volleyball matches. Therefore, it is worth promoting in volleyball training.

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All authors declare no potential conflict of interest related to this article

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**AUTHORS' CONTRIBUTIONS:** The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Liu Yue: writing and execution. Chen Hong: data analysis and article reviews.

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