

EFFECTS OF UPPER LIMB STRENGTH TRAINING ON PHYSICAL FITNESS IN TABLE TENNIS



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EFEITOS DO TREINAMENTO DE FORÇA EM MEMBROS SUPERIORES SOBRE A APTIDÃO FÍSICA NO TÊNIS DE MESA

EFFECTOS DEL ENTRENAMIENTO DE FUERZA EN MIEMBROS SUPERIORES SOBRE LA APTITUD FÍSICA EN TENIS DE MESA

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ABSTRACT

Introduction: Strength training is the basis for all sports and physical training. Evidence suggests that its benefit may extend to the athlete's general physical fitness, although few studies refer to the table tennis player. **Objective:** Study the effect of upper limb strength training on the physical fitness of table tennis players. **Methods:** Twenty sportsmen from a college were selected and randomly divided into two groups. The experimental group had the addition of an upper limb strength training protocol in their training, while the control group continued with conventional training. The experiment lasted eight weeks, with interventions three times a week, at intervals with a minimum of one day. **Results:** Specific fitness varied widely between groups: spinning technique in the experimental group increased from 36.66 ± 6.85 per minute before the experiment to 41.03 ± 7.06 , $P < 0.05$. In the control group, the turning technique was $61.41 \pm 4.73/\text{min}$ to $66.49 \pm 4.74/\text{min}$ after the experiment, $P > 0.05$. **Conclusion:** Complementing the tennis training program with specific upper limb muscle strength training can effectively improve explosive muscle strength in its athletes, substantially increasing physical fitness for table tennis players. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Resistance Training; Upper Extremity; Racquet Sports; Exercise Movement Techniques.

RESUMO

Introdução: O treinamento de força é a base para todo o treinamento físico esportivo. Evidências sugerem que seu benefício possa estender-se para a aptidão física geral do atleta, embora haja poucos estudos referentes ao jogador de tênis de mesa. **Objetivo:** Estudar o efeito do treinamento de força dos membros superiores sobre a aptidão física dos jogadores de tênis de mesa. **Métodos:** Foram selecionados 20 esportistas de uma faculdade, divididos aleatoriamente em dois grupos. O grupo experimental teve em seu treinamento a adição de um protocolo de treinamento de força dos membros superiores, enquanto o grupo controle continuou com o treinamento convencional. O experimento teve duração de 8 semanas, com intervenções três vezes por semana, intervaladas com um mínimo de um dia. **Resultados:** A aptidão física específica variou bastante entre os grupos: a técnica de giro no grupo experimental elevou-se de $36,66 \pm 6,85$ por minuto antes do experimento, para $41,03 \pm 7,06$, $P < 0,05$. No grupo controle, a técnica de giro foi $61,41 \pm 4,73/\text{min}$ para $66,49 \pm 4,74/\text{min}$, após o experimento, $P > 0,05$. **Conclusão:** Complementar o programa de treinamento de tênis com o treino específico de força muscular nos membros superiores pode efetivamente melhorar a força muscular explosiva em seus atletas, incrementando substancialmente a aptidão física para os tenistas de mesa. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento de Força; Membros Superiores; Esportes com Raquete; Técnicas de Exercício e de Movimento.

RESUMEN

Introducción: El entrenamiento de fuerza es la base de todo entrenamiento físico deportivo. Las evidencias sugieren que su beneficio puede extenderse a la condición física general del deportista, aunque existen pocos estudios referidos al jugador de tenis de mesa. **Objetivo:** Estudiar el efecto del entrenamiento de la fuerza de los miembros superiores sobre la forma física de los jugadores de tenis de mesa. **Métodos:** Se seleccionaron 20 deportistas de una universidad, divididos aleatoriamente en dos grupos. El grupo experimental tuvo en su entrenamiento la adición de un protocolo de entrenamiento de la fuerza de los miembros superiores, mientras que el grupo de control continuó con el entrenamiento convencional. El experimento duró 8 semanas, con intervenciones tres veces por semana, con un intervalo mínimo de un día. **Resultados:** La aptitud específica varió ampliamente entre los grupos: la técnica de giro en el grupo experimental aumentó de $36,66 \pm 6,85$ por minuto antes del experimento a $41,03 \pm 7,06$, $P < 0,05$. En el grupo de control, la técnica de giro pasó de $61,41 \pm 4,73/\text{min}$ a $66,49 \pm 4,74/\text{min}$ después del experimento, $P > 0,05$. **Conclusión:** Complementar el programa de entrenamiento de tenis con un entrenamiento específico de la fuerza muscular de las extremidades superiores puede mejorar eficazmente la fuerza muscular explosiva en sus atletas, aumentando sustancialmente la aptitud física de los jugadores de tenis de mesa. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Entrenamiento de Fuerza; Extremidades Superiores; Deportes de Raqueta; Técnicas de Ejercicio con Movimientos.



INTRODUCTION

With the rapid development of the table tennis industry, the gap between all kinds of excellent table tennis players in the world is constantly narrowing. For the game, the winning or losing of the game often depends on the physical quality of the players, as well as the endurance of all kinds of special events and speed.¹ In table tennis, if the most basic table tennis technology is not fully used, it will not be able to win the table tennis game. At present, the cause of table tennis in China is at a peak stage. It can be seen that some athletes have made great efforts to carry out strength training behind winning various competitions.² In addition, coaches also need to learn various means of strength training at home and abroad. If professional athletes continue to explore and research in strength training, then table tennis players will have relatively stable strength, and then play various skills to win the game. In the game, the characteristics of table tennis are mainly divided into balanced and unbalanced attack.³ The traditional strength training is mainly reflected in the balanced state.

In the game, high-quality service is to destroy the tactics of the other side, thus inhibiting the play of the other side's specialty, etc. The service must have a great relationship with the rotation and speed of the ball, and the quality of the service also has two decisive key factors, namely, the integrity and smoothness of the technical action and the precise control of the muscles by the comprehensive quality of the muscle strength.⁴ Although the table tennis players paid some attention to the strength training last week, they did not go deep into the technical aspects of table tennis. Through the research, we can carry out certain technical training on the service technology of table tennis, enrich the training content of table tennis, and thus have certain theoretical significance and time value in this field.⁵ In order to improve the service skills of table tennis players, we can combine the organizational core strength of coaches for theoretical reference. After discussion, this paper formulated the upper limb strength training program. The experiment was carried out by a sophomore table tennis student athlete in a university to explore the effect of upper limb strength training on the optimization of table tennis players' service skills and tactics.⁶

METHOD

Inclusion and exclusion criteria

The research object of this paper is selected from the sophomore table tennis players in a university. In order to ensure the preciseness of the experimental results as much as possible, its inclusion and exclusion should follow the following rules:

1. Athletes are in good health. Currently, there are no congenital diseases that affect sports safety or sports injuries that affect sports effects. In the course of the experiment, if there is any sports injury, we should withdraw in time to avoid the impact of the deviation of the experimental results on the whole experiment.
2. Athletes have a good level of sports, and there is little difference between their performances, so that the deviation of the experimental results caused by the athletes' original performance level can be eliminated.
3. Athletes have good professional quality. They can complete the training tasks at fixed time and in fixed quantity according to the requirements of researchers during the whole process of sports, and maintain a high concentration of spirit during the training process, so as to ensure the quality of training.
4. During the whole training process, if athletes have special circumstances, they should withdraw from the training group in time. Special circumstances include but are not limited to physical health problems, sports injury problems, and time occupation caused by force majeure factors such as examinations and competitions. And excessive fatigue and inability to persist.

Selection of research objects

Through the above inclusion and exclusion criteria, a total of 20 eligible subjects were finally selected and divided into experimental group and control group according to the form of random sampling. The study and all the participants were reviewed and approved by Ethics Committee of Jiangsu University of Technology(NO.JSUT21FN075). The basic information of the two groups of subjects is shown in Table 1. The data are not different from each other and will not interfere with the experimental results.

Design of research methods

The experimental method we designed is a control experiment. In order to prevent the impact of psychological problems on the data of the two groups of subjects, the athletes are called Group A and Group B during the whole experiment process. The athletes do not know whether they are the experimental group or the control group, so that the data will not fluctuate due to psychological problems. Among them, the experimental group corresponds to group A, and the control group corresponds to group B. After the beginning of the experiment, the upper limb strength training was added to Group A, that is, the experimental group, and the upper limb strength module training was completed through dumbbells, single and parallel bars, elastic bands and other equipment. Group B, also known as the control group, continued the existing table tennis training mode without additional adjustment. The whole experiment lasted for 8 weeks. The experimental group and the control group were trained three times a week, with an interval of more than one day. Since the experimental group and the control group are students of the same grade, their daily curriculum design and training arrangements are also the same, and their diet is conducted in the canteen, so as to minimize the interference of other variables on the research results and ensure the preciseness of the experimental results.

Data processing and analysis

Before and after the experiment, the relevant data were sorted and collected, and the data results were analyzed and processed with SPSS software. The specific experimental results are shown in Chapter 3.

RESULTS

Effect of upper limb strength training on upper limb strength of table tennis players

The direct effect of strength training is shown in the improvement effect of upper limb strength of table tennis players. Table 2 of this paper selects two indicators of grip strength and flat brace to analyze them.

Table 2 shows the effect of upper limb strength training on upper limb strength of table tennis players. The research results show that in the daily training of table tennis players, adding the content of upper limb strength training can directly improve the upper limb strength of table tennis players.

The effect of upper limb strength training on the optimization of techniques and tactics of table tennis players serving

The service practice of table tennis includes left push and right attack technique, push - side - attack technique, forehand continuous

Table 1. Basic information of the two groups of subjects.

Project	Experience group	Control group	P value
Height (cm)	179.365±4.631	178.696±4.794	0.100
Body weight (kg)	71.281±11.309	64.222±7.614	0.092
Age (years)	20.070±1.199	20.171±1.410	0.074
Training years (years)	12.185±1.681	12.255±2.139	0.093

serve attack technique, forehand pull down spin technique, backhand continuous serve attack technique, backhand pull down spin technique and other techniques. This is analyzed in Table 3 of this article.

Table 3 shows the influence of upper limb strength training on the basic service skills of table tennis players. The research results show that under the same training of table tennis service skills and tactics, increasing the upper limb strength training can make the players more comfortable when serving, and the number of serving has also been significantly improved.

The technical and tactical scores of table tennis players are divided into accuracy scores and technical scores, which are analyzed in Table 4.

Table 4 shows the effect of upper limb strength training on the technical and tactical scores of table tennis players. The accuracy score of the experimental group was 7.515 ± 1.848 before the experiment, and increased to 8.960 ± 1.995 after the experiment, $P=0.044 < 0.05$; The accuracy score of the control group was 7.798 ± 1.913 before the experiment, and increased to 8.048 ± 1.448 after the experiment, $P=0.085 > 0.05$, indicating that there was no significant difference. The technical score of the experimental group was 6.316 ± 2.472 before the experiment, and it was 8.290 ± 1.630 after the experiment, $P=0.032 < 0.05$; The accuracy score of the control group was 6.242 ± 2.649 before the experiment, and increased to 7.591 ± 1.187 after the experiment, $P=0.091 > 0.05$, indicating that there was no significant difference. It can also be seen from the coaches' technical and tactical scores of athletes that after the end of the experiment, the score of the experimental group is higher than that of the control group, indicating the importance of increasing upper limb strength training.

DISCUSSION

In modern sports, physical fitness of various competitive sports is the most critical factor. Among all kinds of physical training, strength training is the core foundation of all sports. All sports items need to be supported by muscle strength in special technical performance, and strength training is an essential and important content in daily sports training. At the same time, various experts at home and abroad have enriched the strength training theory and made it more systematic and scientific. From the original simple dynamic machinery to modern various instruments, you can use your own weight to train muscles. With the continuous development of strength training, Chinese athletes have also made continuous breakthroughs in competition results and constantly set various world records.

Table 2. Effect of upper limb strength training on upper limb strength of table tennis players.

Project	Experience group			Control group		
	Before experiment	After experiment	P value	Before experiment	After experiment	P value
Grip strength (kg)	43.145±6.645	47.170±6.692	0.040	43.095±5.393	46.869±7.148	0.092
Flat brace (min)	24.666±3.464	31.637±4.252	0.045	24.670±3.362	26.839±3.566	0.045

Table 3. Effect of upper limb strength training on the basic service skills of table tennis players (multiple balls per minute).

Project	Experience group			Control group		
	Before experiment	After experiment	P value	Before experiment	After experiment	P value
Left push and right attack technology	39.631±5.843	44.973±6.857	0.002	38.889±6.123	42.033±7.150	0.080
Push-Side-Flop Technology	16.127±3.886	21.304±4.962	0.002	17.401±4.163	19.476±4.768	0.091
Forehand continuous serve	88.113±2.759	94.493±3.286	0.018	87.019±2.547	92.791±2.896	0.063
Forehand backspin	36.667±6.856	41.030±7.060	0.021	61.414±4.737	66.499±4.746	0.051
Backhand continuous serve	62.829±4.325	66.743±4.319	0.037	38.123±5.653	39.472±6.725	0.069
Backhand backspin	29.714±6.121	34.941±6.928	0.041	31.961±7.317	34.354±8.273	0.064

When the athlete is leading the racket, when the body bends forward with the counterclockwise rotation, it can decrease from the preparation of the posture to the end of the lead racket. When the muscles of the upper arm movement are located in the front of the main deltoid muscle, the biceps brachii of the upper arm will converge internally, and at the same time, the external pronator muscle group that pulls outward will be produced. Different pulling effects will stimulate the elastic potential energy in the muscle, and then make the muscle contraction more rapid and powerful. With the clockwise rotation of the trunk, The angular velocity of the shoulder joint will also increase rapidly with the lateral rotation until it reaches the peak at the stage of touching the ball. During the contraction of a long muscle in the upper arm, the contraction of the back of the deltoid muscle and the teres minor muscle will cause the upper arm to rotate outward. Therefore, it is necessary to pay attention to strengthen the exercise of the abductor and supinator muscles during the training.

In the process of the preparation posture of the back-pull technique and the action of the end of the lead, the angle of the elbow joint needs to be increased, and the forearm will be extended with the forward bending of the body as the forearm rotates inward. After the lead racket is over, the angle of the elbow joint is larger. With the continuous progress of the grab pull technology, the lead racket technology can be stretched upward at the stage of swinging and touching the ball, and then the angle and speed of the joint are increased sharply.

Because the action range of the technical lead racket is small, the change of the elbow angle is not particularly obvious. In order to keep the position of the elbow angle unchanged during the swing, it is necessary to improve the grasp of the ball while maintaining the stability of the forearm. When the elbow joint is fixed as a support point, it is necessary to extend the movement distance between the forearm and the hand in order to extend the action time of the force, so as to achieve the goal of volleyball movement speed. When bending and rotating the elbow joint, it is necessary to extend the action time of the force in order to increase the swing distance. On the premise of ensuring the speed of the action in terms of the action distance and time of the force, the forearm of the wrist joint also needs to be flexed and extended. There are flexor pollicis longus and flexor digitorum profundus in the deep layer. At the wrist joint, the muscle group is located inside the elbow joint, and there are extensor carpi ulnaris and flexor carpi lateralis. The upper limb force training can effectively optimize these muscles and optimize the tactical skills of the athletes.

Table 4. Effect of upper limb strength training on the technical and tactical scores of table tennis players.

Project	Experience group			Control group		
	Before experiment	After experiment	P value	Before experiment	After experiment	P value
Accuracy score	7.515±1.848	8.960±1.995	0.044	7.798±1.913	8.048±1.448	0.085
Technical score	6.316±2.472	8.290±1.630	0.032	6.242±2.649	7.591±1.187	0.091

CONCLUSION

This paper discusses the influence of upper limb muscle strength training on table tennis service skills by adding the upper limb muscle strength training module to the existing table tennis training. The experimental results show that adding the training content of upper limb muscle strength to the existing table tennis training program can effectively improve the upper limb muscle strength and explosive force, improve the swing strength, and then assist with the same technical and tactical teaching operation, can well improve the technical and tactical level of table tennis players serving. Therefore, the training program in this paper is worth promoting, but the experiment in this paper still has

shortcomings. That is, the selection of the research object is only for 20 athletes in one school. In the follow-up study, the sample range needs to be expanded to improve the rigor and accuracy of the experiment.

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