TRAINING TO IMPROVE THE PHYSICAL FITNESS OF TABLE TENNIS PLAYERS

TREINAMENTO PARA MELHORAR A APTIDÃO FÍSICA DE JOGADORES DE TÊNIS DE MESA

ENTRENAMIENTO PARA MEJORAR LA CONDICIÓN FÍSICA DE LOS JUGADORES DE TENIS DE MESA

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ABSTRACT

Introduction: Table tennis is a technical game with nets. The direction changes, ball accelerations, and considerable extensions of table tennis make it more expressive. Physical training is an essential step of physical preparation by contemporary Chinese players. Objective: Discuss the effects of physical training on table tennis players. Methods: A randomized collection was used to select 16 table tennis players. A training follow-up was conducted for one year, with exercises three times a week. Training intensity data and success rate of hitting evolution were statistically analyzed. Results: The ability of table tennis players was improved after one year of physical training under the presented protocol($P<0.05$). There was no significant difference in lactate, heart rate, and success rate before and after the intervention($P<0.05$). Conclusion: Physical training is essential to improve the energy delivery systems of phosphagen, phosphagen glycolysis, and glycolysis. Physical training is the key to improving table tennis players' performance and physical quality. Coaches can use the results of this article to monitor the special physical training of athletes. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Racquet Sports; Training, Exercise; Athletes; Sports.

RESUMO

Introdução: O tênis de mesa é um jogo de técnica com redes. As mudanças de direção, acelerações da bola e extensões consideráveis do tênis de mesa o tornam mais expressivo. O treinamento físico é uma etapa essencial da preparação física por parte dos jogadores chineses contemporâneos. Objetivo: Discutir os efeitos do treinamento físico sobre os jogadores de tênis de mesa. Métodos: Utilizou-se uma coleta aleatória para selecionar 16 jogadores de tênis de mesa. Foi realizado um acompanhamento de treinamento por um ano, com exercícios três vezes por semana. Os dados de intensidade do treinamento e a taxa de sucesso da evolução dos acertos foram analisados estatisticamente. Resultados: A habilidade dos jogadores de tênis de mesa foi aprimorada após um ano de treinamento físico sob o protocolo apresentado($P<0,05$). Não houve diferença significativa no lactato, frequência cardíaca e taxa de sucesso antes e depois da intervenção($P<0,05$). Conclusão: O treinamento físico é essencial para melhorar os sistemas de fornecimento de energia de fosfágeno, glicólise de fosfágeno e glicólise. O treinamento físico evidenciou ser a chave para melhorar o desempenho e a qualidade física dos jogadores de tênis de mesa. Os treinadores podem utilizar os resultados deste artigo para monitorar o treinamento físico especial dos atletas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Esportes com Raquete; Treinamento Físico; Atletas; Esportes.*

RESUMEN

Introducción: El tenis de mesa es un juego técnico con redes. Los cambios de dirección, las aceleraciones de la pelota y las considerables extensiones del tenis de mesa lo hacen más expresivo. El entrenamiento físico es un paso esencial de la preparación física de los jugadores chinos contemporáneos. Objetivo: Discutir los efectos del entrenamiento físico en los jugadores de tenis de mesa. Métodos: Se utilizó una colección aleatoria para seleccionar 16 jugadores de tenis de mesa. Se realizó un seguimiento del entrenamiento durante un año, con ejercicios tres veces por semana. Se analizaron estadísticamente los datos de la intensidad del entrenamiento y la tasa de éxito de la evolución de los golpes. Resultados: La capacidad de los jugadores de tenis de mesa mejoró tras un año de entrenamiento físico con el protocolo presentado ($P<0,05$). No hubo diferencias significativas en el lactato, la frecuencia cardíaca y la tasa de éxito antes y después de la intervención ($P<0,05$). Conclusión: El entrenamiento físico es esencial para mejorar los sistemas de suministro de energía del fosfágeno, la glucólisis del fosfágeno y la glucólisis. El entrenamiento físico ha demostrado ser la clave para mejorar el rendimiento y la calidad física de los jugadores de tenis de mesa. Los entrenadores pueden utilizar los resultados de este artículo para controlar la preparación física especial de los deportistas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Deportes de Raqueta; Entrenamiento Físico; Atletas; Deportes.*

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INTRODUCTION

Aiming at the phenomenon of "emphasizing technique and ignoring physical strength" in the current table tennis training in China, the academic circles put forward the necessity of cultivating students' unique abilities. Table tennis is a technology-based confrontational game. Its sports results mainly depend on the tactical and technical level of the athletes.[1] The energy supply and mental state of the athlete's energy metabolism system are the main factors affecting their athletic performance.

Excellent physical fitness is a critical way to improve table tennis. Good physical fitness helps to improve the physical function of the athlete. This can encourage them to use more tactics in the table tennis game to obtain better results. Conversely, if there is no good physical fitness, even the best tactics and techniques will not be able to achieve the best state.[2] The physical fitness of the athlete will also allow the athlete to maintain a high endurance during high-intensity exercise. Special physical training allows athletes to perform various techniques and tactics while maintaining a good competitive state. Only in this way can the athlete achieve a higher level of competition. Physical exercise must not be ignored in the regular table tennis training. In this paper, a set of training programs is formulated according to the characteristics of the table tennis players' training system, which is not perfect, and the technical level is not stable.[3] This paper analyzes it is physiological and training characteristics. The research results of this paper provide a reference for college coaches to monitor the special physical training of athletes.

METHOD

Subjects

In this paper, 16 table tennis players are selected by random sampling. The average height is 165.42±4.19, and the average age is 20.18±1.33.

Investigation method

This article conducts a one-year follow-up training for athletes. The athlete performed the exercise frequency three times per week.[4] This article records each shot's intensity, density, and success rate.

In this paper, athletes' heart rate before and after training was measured using the POLAR heart rate tester from FINLAND. This paper uses its processor to analyze and process the stored data. This paper detected it by a YSI-1500 lactic acid analyzer.[5] The success rate of serving is calculated based on the effective return of the player

Construction of table tennis motion analysis model

This paper proposes a data acquisition algorithm based on two targets. In the system model, the coordinate system established by the ping-pong racket is a pole composed of two directions formed by the positive-sum and the polar angle.[6] The coordinate system P_1 established by the table tennis racket in the system model is the pole, the direction X_1 is the positive direction of the polar angle, and β_1 and β_2 are the angles formed by the Y_1 and X_1 sides, respectively. The coordinate system established by table tennis is similar. P_2 is the pole, X_2 is the positive direction of the polar angle, and β_3 and β_4 are the angles formed by the Y_2 and X_2 sides, respectively. In this way, we can use the polar coordinate equation $g\ (u, \beta)$ to establish the mathematical relationship of the double-object hoof shape of the table tennis motion system. u is the emotional distance between points P_1 and P_2 in the system function $g\ (u, \beta)$. The constructor $g\ (x, y)$ of the double-target hoof channel composed of ping-pong rackets and ping-pong balls is:

$$\begin{cases} x = X_1 + u\cos\beta\sin\left(b\beta + \arctan\left(\dfrac{Y_2}{X_2}\right) + \beta_4\right) \\ y = Y_1 + u\sin\beta\cos\left(b\beta + \arctan\left(\dfrac{Y_2}{X_2}\right) + \beta_3\right) \end{cases} \quad \beta_1 \le b\beta \le \beta_2 \quad (1)$$

Based on the binocular hoof model, this paper simulates the DCT value of table tennis. Because DCT is based on discrete points, a rounding function is used in Eq. (1).

$$\begin{cases} x = X_1 + u\cos\beta\sin\left|\beta k + \arctan\left(\dfrac{Y_2}{X_2}\right) + \beta_4\right| \\ y = Y_1 + u\sin\beta\cos\left|\beta k + \arctan\left(\dfrac{Y_2}{X_2}\right) + \beta_3\right| \end{cases} \quad \beta_1 \le b\beta \le \beta_2 \quad (2)$$

We discretize the points on a beam into an integrated point. In this paper, the number of points after discretization is N. This article uses a linear function $\lambda_1\ (u_b, \beta)$ to express, where the subscript b represents b+1 discrete points. Through the definition of one-dimensional DCT, we can get the DCT of a particular ray $\lambda_1\ (u_b, \beta)$:

$$G_1(U_b, \beta) = Fu(\lambda_1(u_b, \beta)) = Cb\sum_{k=0}^{N-1}\lambda_1(u_b, \beta)\cos\frac{(2b+1)Ub\pi}{2N} \quad (3)$$

$$Ck = \begin{cases} \dfrac{2}{\sqrt{N}} & b = 0 \\ \sqrt{\dfrac{2}{N}} & b \ne 0 \end{cases} \quad (4)$$

Once again, we can derive the inverse transformation formula

$$\lambda_1(u_b, \beta) = \sqrt{\frac{1}{N}}G_1(u_0, \beta) + \sqrt{\frac{2}{N}}\sum_{b=1}^{N-1}G_1(U_b, \beta)\cos\frac{(2b+1)U_b\pi}{2N} \quad (5)$$

ETHICAL COMPLIANCE

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Heze University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

Statistics

This paper uses SPSS19.0 software to calculate the mean and standard deviation. In this paper, the mean t is tested.

RESULTS

Physical training improves the energy supply of the ATP-CP system of football players

Table tennis is an intermittent, short-term explosive movement with a ball. Multiball training can cultivate the essential qualities of athletes. Multiball training has become a standard method.[7] The

6-month special physical training includes three sets of rapid arm swing + footwork movement, 1/4 multiball training, 1/2 attack, etc. After the multiball training, the physical fitness of the athletes has been dramatically improved. Both blood lactate and heart rate decreased after multiball training. Increased body load tolerance. In addition, football players' service hit rate has improved to a certain extent. (Table 1)

The energy supply of ATP-CP/glycolysis mixed system for athletes with remarkable physical development

In this paper, the energy supply of the ATP-CP/glycolysis hybrid system can effectively improve the tolerance of fast movements and arm swings of table tennis players. In special physical training, football players use the maximum strength of 30 to 60 S for exercise. Each exercise is 4-5 minutes apart. After five times of intermittent training, the blood lactate level of football players can reach a higher level. As shown in Table 2, the anaerobic capacity of the athletes was significantly enhanced.[8] Athletes will produce high blood lactate during anaerobic training to promote the glycolytic system's energy supply and speed endurance.

The energy development of athletes' glycolysis system by the exceptional physique

Athletes need some acid resistance to ensure high-intensity exercise in low-oxygen conditions. The content of the exercise includes pull-pull, 1/2 attack pull-pull, and side-pull push-pull method. Athletes rest for 4-5 minutes after 1-2 minutes of high-intensity exercise.[9] This allows the athlete to withstand longer exercise loads. As shown in Table 3, the effect of forwarding, backward push, and side throw training is significant. Speed and endurance have improved. When the training intensity is lower than four mmol/L, table tennis players' oxidative system energy and remarkable endurance can be improved.

Table 1. Changes in blood lactate, heart rate, and hitting success rate before and after the first group of training methods.

Content		Quick arm swing + footwork movement	1/4 multiball training
Heart rate (times/min)	Before training	75.15 ± 0.19	74.67 ± 0.48
	After training	72.49 ± 1.05	71.54 ± 0.76
Blood lactate (mmol/L)	Before training	4.28 ± 0.57	3.99 ± 0.67
	After training	3.8 ± 0.38	3.61 ± 0.76
Batting success rate (%)	Before training	21.85 ± 1.14	88.54 ± 1.14
	After training	24.7 ± 2	90.35 ± 1.05

Table 2. Changes in blood lactate, heart rate, and hitting success rate before and after the second group of training methods.

Content		Push left and right attack (multiple balls)	1/4 push block sideways (multiball)
Heart rate (times/min)	Before training	74.96 ± 0.38	75.81 ± 0.67
	After training	72.49 ± 1.33	72.87 ± 1.43
Blood lactate (mmol/L)	Before training	4.09 ± 0.19	3.99 ± 0.76
	After training	3.8 ± 0.48	3.52 ± 0.76
Batting success rate (%)	Before training	84.93 ± 3.04	86.36 ± 1.52
	After training	89.49 ± 2	89.4 ± 4.28

Table 2. Changes in blood lactate, heart rate, and hitting success rate before and after the third group of training methods.

Content		1/2 attack, pull, and rush (multiple balls)	Push side throw (multiple balls)
Heart rate (times/min)	Before training	75.53 ± 0.57	76.57 ± 0.29
	After training	73.63 ± 1.33	73.44 ± 0.76
Blood lactate (mmol/L)	Before training	4.37 ± 0.38	4.56 ± 0.48
	After training	3.8 ± 0.57	3.71 ± 0.67
Batting success rate (%)	Before training	84.65 ± 2.09	77.43 ± 3.04
	After training	87.69 ± 1.71	82.08 ± 2

DISCUSSION

Physical fitness training of table tennis players serves tactics and techniques. A physical exercise is a form of training. Its ultimate goal is to advance the execution of offensive and defensive technical and tactical plans. In the physical fitness training of table tennis players, special attention should be paid to the cultivation of particular physical fitness. Table tennis has its characteristics.[10] Physical training should be combined with table tennis tactics and techniques. In this way, the physical fitness of athletes can be better exercised. Continuous improvement and inspection of relevant techniques and tactics in physical education can ensure that athletes can improve their physical fitness during tactical training. Coaches should arrange training scientifically and reasonably regarding physical fitness, training level, and training intensity of table tennis players.

All table tennis players must combine high-intensity training methods' characteristics. In this way, the physical load at different stages can be summarized. This can provide a reference for table tennis players to reasonably arrange training time and intensity. Therefore, football players must pay more attention to the interval time in high-intensity training.[11] Coaches need to pay attention to the actual requirements of interval training in the new era. At the same time, athletes need to reasonably control the load and interval time in training so that athletes can better arrange the details of sports during high-intensity training. This article focuses on the study and analysis of high-intensity interval training. In this way, athletes can better adapt to the table tennis environment during high-intensity interval training. At the same time, football players should also pay attention to the critical factor of heart rate. Coaches need to consider athletes' emotional needs to design a better heart rate control strategy. In this way, athletes can achieve fine control over the movement of table tennis.[12] Every good table tennis designer must pay attention to traditional tactical training to effectively identify the physical load of the player. In this way, the trainer can formulate a more scientific high-intensity training plan based on data such as heart rate.

Athletes must take the optimization of physical fitness as an essential method to judge the value of their sports when performing the high-intensity intermittent exercise so that they can occupy a central position in high-intensity intermittent exercise. This paper investigates the characteristics of heart rate variability in athletes during high-intensity interval training from an aerobic point of view.[13] This article comprehensively and effectively recognizes changes in various physiological functions associated with the physical load. This allows athletes to maintain the practice of high-intensity interval training better. The athlete also allows the athlete to fully adapt to the modification of the training activity pattern while maximizing the control of the athlete's physical load. In this way, the goal of adapting to the physical load of the athlete can be achieved.

CONCLUSION

After more than six months of physical training, the unique abilities of table tennis players, such as aerobic metabolism, have been significantly improved. The training level of athletes has also improved significantly. Players' shooting percentages also improved as their stamina improved. There was no significant difference between the ATP-CP, glycolysis hybrid system, and glycolysis system before and after training.

The authors declare that they have no competing interests.

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