

IMPACTS OF HIGH-INTENSITY INTERVAL TRAINING ON PHYSICAL FITNESS IN HANDBALL



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IMPACTOS DO TREINAMENTO INTERVALADO DE ALTA INTENSIDADE SOBRE A APTIDÃO FÍSICA NO HANDEBOL

IMPACTOS DEL ENTRENAMIENTO POR INTERVALOS DE ALTA INTENSIDAD EN LA APTITUD FÍSICA EN EL BALONMANO

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ABSTRACT

Introduction: Handball is a competitive sport with high demands on the physical fitness of its athletes, being physical exercise demands continuous quality improvement of its practitioners. **Objective:** Explore the effect of high-intensity interval training on physical fitness in young handball players. **Methods:** In this paper, 46 young handball players were randomly selected for the research. The volunteers were randomly divided into two different groups: the experimental group and the control group. The control group mainly performed regular physical exercises. While the experimental group performed a protocol with high-intensity interval training. Both groups underwent a basic fitness test before and after the experiment. All experimental data were statistically analyzed and discussed. **Results:** After 12 weeks of experimental intervention, the experimental group showed significant differences in three items, namely reentry sensitivity, vertical jump, and long position jump ($P<0.05$). In the comparison between the groups, the scores in straight thrust and long jump were also significant ($P<0.05$). **Conclusion:** High-intensity interval training proved effective in improving young handball players' physical fitness. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: High-Intensity Interval Training; Adolescent; Athletes; Physical Conditioning, Human.

RESUMO

Introdução: O handebol é um esporte competitivo que tem altas exigências quanto à aptidão física de seus atletas sendo o exercício físico uma demanda para a melhoria contínua da qualidade de seus praticantes. **Objetivo:** Explorar o efeito do treinamento intervalado de alta intensidade sobre a aptidão física em jovens jogadores de handebol. **Métodos:** Neste artigo, 46 jovens jogadores de handebol foram aleatoriamente selecionados para a pesquisa. Os voluntários foram divididos aleatoriamente em dois grupos diferentes: o grupo experimental e o grupo de controle. O grupo de controle realizou principalmente exercícios físicos regulares. Enquanto o grupo experimental realizou um protocolo com treinamentos intervalados de alta intensidade. Ambos os grupos foram submetidos a um teste de aptidão básica antes e depois do experimento. Todos os dados experimentais foram analisados estatisticamente e discutidos. **Resultados:** Após 12 semanas de intervenção experimental, o grupo experimental mostrou diferenças significativas em três itens, a saber: sensibilidade de reentrada, salto vertical e salto em posição longa ($P<0,05$). Na comparação entre os grupos, as pontuações no impulso reto e no salto à distância também foram significativas ($P<0,05$). **Conclusão:** O treinamento intervalado de alta intensidade mostrou-se eficaz para o aprimoramento da aptidão física dos jovens jogadores de handebol. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento Intervalado de Alta Intensidade; Adolescente; Atletas; Condicionamento Físico Humano.

RESUMEN

Introducción: El balonmano es un deporte de competición que tiene una alta exigencia en la condición física de sus deportistas, siendo el ejercicio físico una exigencia para la mejora continua de la calidad de sus practicantes. **Objetivo:** Explorar el efecto del entrenamiento por intervalos de alta intensidad sobre la aptitud física de jóvenes jugadores de balonmano. **Métodos:** En este trabajo, 46 jóvenes jugadores de balonmano fueron seleccionados al azar para la investigación. Los voluntarios fueron divididos aleatoriamente en dos grupos diferentes: el grupo experimental y el grupo de control. El grupo de control realizó principalmente ejercicios físicos regulares. Mientras que el grupo experimental realizó un protocolo con entrenamiento de intervalos de alta intensidad. Ambos grupos se sometieron a una prueba de aptitud física básica antes y después del experimento. Todos los datos experimentales se analizaron y discutieron estadísticamente. **Resultados:** Tras 12 semanas de intervención experimental, el grupo experimental mostró diferencias significativas en tres ítems, a saber, la sensibilidad de reentrada, el salto vertical y el salto en posición larga ($P<0,05$). En la comparación entre los grupos, las puntuaciones en empuje recto y salto de longitud también fueron significativas ($P<0,05$). **Conclusión:** El entrenamiento interválico de alta intensidad demostró ser eficaz para la mejora de la condición física de los jóvenes jugadores de balonmano. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Entrenamiento de Intervalos de Alta Intensidad; Adolescente; Atletas; Acondicionamiento Físico Humano.



INTRODUCTION

The quality of physical fitness directly reflects the quality of competitive sports. It is not something that can be achieved overnight. The improvement of the physical fitness of athletes must be obtained through long-term and regular exercise. The competitive process of handball is highly competitive. This sport requires athletes to perform explosive jumps and short sprint competitions in a short period. To meet the needs of handball competitions, athletes must have scientific plans regarding training content, training methods, training time, and training methods. For example, a handball game takes 60 minutes. The average distance for each game is more than 10 meters. This requires higher physical fitness. High-intensity interval training is a form of exercise in which the exercise load exceeds the anaerobic threshold during training.¹ The time is generally controlled within 5-300 seconds. The two rest intervals in this sports training do not fully allow the athlete to recover. High-intensity interval training is an efficient, emerging form of exercise. It has been widely used in body shaping and fat reduction, physical education, and exercise for the masses. This paper uses an interventional experiment of high-intensity interval training to explore its effect on the physical fitness of young handball players.

METHOD

General information

This paper selects 46 young handball players for investigation. In this paper, the research subjects are randomly divided into two groups in different ways: one is the experimental group, and the other is the control group.² The basic information on the two study subjects is listed in Table 1.

Investigation method

This paper measured the five essential physical fitness of the subjects. There was no significant difference in physical fitness between the two groups. The experimental period was 12 weeks. Regular physical exercise every Tuesday and Thursday afternoon. Preliminary training and leisure time scheduling activities are the same. After 12 weeks, the second basic physical fitness test was conducted.³ The test items include vertical jump, straight sprint, reentry sensitivity, forward throwing medicine ball, standing long jump, etc.

Movement rate prediction of handball

The details of the trajectory of the handball's parabolic motion are not a slow-to-fast and then fast-to-slow process. On the whole, the handball parabola is a relatively easy-to-define parabola. This paper proposes a piecewise periodic curve fitting method based on the maximum projected motion rate. This method can well solve the problems in the projection process and make the projection movement more precise.⁴ Points We iterate with a method of 10 pairs of points. The purpose is to get the best results for both the fitting accuracy and the time-consuming calculation. The ten pairs of points in the loop are defined as follows. First of all, this paper selects $(\alpha_1, \theta_1), (\alpha_2, \theta_2), \dots, (\alpha_{10}, \theta_{10})$ as the first pair of points. This paper selects $(\alpha_2, \theta_2), (\alpha_3, \theta_3), \dots, (\alpha_{11}, \theta_{11})$ as the second pair of points. The cubic polynomial expression in the two-dimensional space is as follows:

Table 1. Basic information about athletes.

Group	Test Group	Control group
n	23	23
Age	13.88±1.93	14.15±1.61
Weight/kg	62.59±9.82	66.19±12.33
Height/cm	175.06±10.05	180.47±8.45
Training years	2.55±0.34	2.41±0.54

$$\theta = A1 * \alpha^3 + A2 * \alpha^2 + A3 * \alpha + A4 \tag{1}$$

Assume that the point pair selected in this paper is $(\alpha_1, \theta_1), \dots, (\alpha_{10}, \theta_{10})$ in a series of flow velocity graphs, and express it as:

$$X = \begin{pmatrix} \alpha_1^3 & \alpha_1^2 & \alpha_1 & 1 \\ \alpha_2^3 & \alpha_2^2 & \alpha_2 & 1 \\ \vdots & \vdots & \vdots & \vdots \\ \alpha_{10}^3 & \alpha_{10}^2 & \alpha_{10} & 1 \end{pmatrix}, Y = \begin{pmatrix} \theta_1 \\ \theta_2 \\ \vdots \\ \theta_{10} \end{pmatrix}, \Theta = (A1, A2, A3, A4)^T \tag{2}$$

This paper uses the parameter estimation principle of linear mode to give the best estimation value: $\Theta = (X^T X)^{-1} X^T Y$

X is the number of dots in ten rows and four columns. Y is the number of pairs in ten rows and one column. Θ is the number of pairs in four rows and one column. The three-dimensional surface equation consisting of 10 pairs of points can be found in Equation 2. On this basis, this paper can further obtain a tangent equation of a solid surface at a certain point $(\alpha_k, \theta_k, \lambda_k)$ in space:

$$\frac{\alpha - \alpha_k}{\alpha'(\delta_k)} = \frac{\theta - \theta_k}{\theta(\delta_k)} = \frac{\lambda - \lambda_k}{\lambda(\delta_k)} \tag{3}$$

From formula (3), it can be determined that the moving direction of the projected virtual target is $(\alpha'(\delta_k), \theta(\delta_k), \lambda(\delta_k))$.

Data Analysis

This paper used SPSS19.0 for statistical analysis of the experimental results in the pre-intervention and post-intervention experiments. Data were recorded as mean ± standard deviation.⁵ The data in a single group before and after the experiment were analyzed by paired t-test. The data between the groups were compared using a separate t-test.

Ethical Compliance

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

RESULTS

The basic physical fitness assessment includes speed, agility, and explosiveness. The 30-meter long-distance running is a comprehensive index of speed quality evaluation. It reflects a handball player's straight-line sprint over short distances.⁶ The player's reentry susceptibility test simulates the opponent's fast attacking and defensive transitions. The vertical jump and the long vertical jump are the way to test the athlete's legs' vertical jump and the lateral muscles' explosive power. The forward throw of the medicine ball can reflect the explosive power of the upper arm of the athlete. The only thing missing is that no corresponding endurance indicator is included in this physical fitness test assessment.

It can be seen from Table 2 that there was no difference in the scores of physical fitness indicators between the two groups before and after physical training intervention ($P > 0.05$). This provided the basis for post-intervention comparisons.⁷ After 12 weeks of physical training intervention, there were significant differences between the experimental and control groups in the three assessment indicators of reentry sensitivity, vertical jump, and standing long jump ($P < 0.05$). Compared with the control group, there were significant differences between the two items of straight sprint and standing long jump in the experimental group ($P < 0.05$).

Table 2. Comparison of test scores between the two groups of athletes before and after the intervention.

Test items	Before intervention		P
	Control group	Test Group	
Straight line sprint test	78.13±15.45	71.18±1.16	P>0.05
Reentry Sensitivity Test	75.52±10.8	78.99±19.6	P>0.05
Vertical jump	76.39±16.69	85.07±11.72	P>0.05
Standing long jump	87.68±20.15	85.94±22.28	P>0.05
Forward medicine ball	88.54±8.07	81.59±9.13	P>0.05
Test items	After intervention		P
	Control group	Test Group	
Straight line sprint test	90.28±7.84	90.28±6.31	P>0.05
Reentry Sensitivity Test	78.99±6.93	94.61±6.93	P<0.05
Vertical jump	77.26±15.59	91.15±8.55	P<0.05
Standing long jump	92.01±16.69	97.22±9.13	P<0.05
Forward medicine ball	89.41±7.67	83.33±8.72	P>0.05

DISCUSSION

Handball is a fast, powerful, and aggressive sport. Athletes' physical fitness is the premise and guarantees for athletes to obtain good sports results. The physical fitness characteristics of handball players, the characteristics of technical and tactical use in handball games, and the characteristics of athletes' different positions will all have a particular impact on the performance of athletes.⁸ The targeted training of handball players will improve their physical fitness. Coaches must frequently test and evaluate the physical fitness level of the players. Coaches need to test the physical fitness of athletes to formulate training plans based on the test results. Speed is a crucial assessment indicator for handball players. The speed of handball competition is a total reflection of displacement, action speed, reaction speed, and take-off speed.⁹ The running characteristics of handball competitions are short displacement distance, many times, and many changes in direction and speed. In a handball match, each player moves 115 times within 10 meters. Accounting for 71% of the total number of fast moves. The high-speed movement of 10 meters is 48 times per person, and the maximum high-speed movement of the handball player is 40 meters.

Handball is not limited to defense and counter-attack. Now handball players must have enough time to break through the opponent's defense. Moving faster can improve the defensive qualities of a handball defender.¹⁰ If the handball player's defense is faster than the opponent's attack, then the opponent's offensive situation will be disturbed by the attack of the defending player; conversely, if the opponent's handball player's attack is better than the defender's defense. At this time, the opponent's attackers can formulate a better shooting plan and carry out different tactical combinations with our players. The quick, accurate, and ruthless defensive action at the moment guarantees victory. The technical advantages and characteristics of Asian women's handball are fast and agile. This requires that handball players must be able to complete technical movements quickly.¹¹ The best time to shoot is concise.

The shot is done in an instant. The only way for a handball attacker to score a goal is to improve the speed of passing the ball. In handball, players mainly rely on visual judgment. Athletes must react quickly to the ball, and the opponent changes. In handball competitions, jumping, emergency stops, and frequent transitions require better reaction speed.

Handball is a sport that combines speed and endurance. The handball player can adjust according to the attacking and defensive situation on the field.¹² Athletes sometimes need to run fast, and sometimes the game is stopped because of out-of-bounds or fouls. A defense time is 28.95±11.87 seconds. The body's energy supply depends entirely on the breakdown of carbohydrate enzymes. Our training focuses on "aerobic metabolism is fundamental, and anaerobic is auxiliary." The purpose of this training method is to improve the specific physical level of handball further,

Handball players have a relatively large range of motion for each joint in the body. Among them, the range of motion of the waist and upper extremity shoulder joints is the largest. The flexibility of the shoulder joint is an essential element for handball players to achieve excellent results. Coaches must focus on special flexibility exercises on athletes' shoulders, knees, and hip joints to prevent sports injuries. The starting technique requires fast speed and great strength. The technique requires the athlete to have great speed and strength. Take-off is a widespread technique. The take-off technique requires the strength and bounce of the legs. The pace and displacement speed of the handball player is crucial in attack and defense. About 75% of the points in a handball game come from offense. Compared with the offense, the fast break is fast-moving and fast-passing, changing the offensive rhythm to break the defense. The fast break has better confrontation strength. The defensive tactics training in handball games should be proactive, regional, and aggressive. Handball players must "consider both the human and the ball, and respond to defense." Defenders should have comprehensive skills, fast movement, good endurance, and coordination of upper and lower limbs and bodies. In this way, the defensive player will have a better ability to fight against each other.

CONCLUSION

High-level high-intensity interval training can improve the essential physical fitness of juvenile handballs. High-intensity interval training can save much time compared to regular physical exercise. Athletes can achieve better physical fitness through this training method. More ball players can adopt this training method. High-level high-intensity interval training has particular application value and universality.

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