# ANALYSIS OF THE EFFECT OF HIGH INTENSITY INTERMITTENT TRAINING FOR YOUNG ATHLETES

*ANÁLISE DO EFEITO DO TREINAMENTO INTERMITENTE DE ALTA INTENSIDADE PARA JOVENS ATLETAS*

*ANÁLISIS DEL EFECTO DEL ENTRENAMIENTO INTERMITENTE DE ALTA INTENSIDAD EN ATLETAS JÓVENES*

**Original Article**
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## ABSTRACT

Introduction: The CPC Central Committee and the State Council have pointed out that currently, the basic indicators of young students' physical health have completely declined. This circumstance has made adolescent physical health and improving the quality of young athletes a key issue in physical education targeting adolescents. Objective: Investigate the effect of high-intensity intermittent training on young athletes. Methods: 24 adolescents performed 10 intermittent high-intensity training for one month, and all athletes' pre and post-training indexes were collected and compared. Results: The physical examination results of male and female athletes improved to some extent (athletes' blood pressure fluctuated during the 10 training sessions, increasing slightly, and heart rate variability increased considerably ($P < 0.05$). Conclusion: High-intensity intermittent training has a good effect on health promotion in young athletes, and can effectively improve their physical function and competitive performance. Physical education teachers and student-athletes should conduct relevant training. In addition, this training method also fits the current learning life situation of high school students. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

**Keywords:** Adolescent; Athletes; High-Intensity Interval Training; Evaluation of Results of Preventive Actions.

## *RESUMO*

*Introdução: O Comitê Central do CPC e o Conselho de Estado destacaram que, atualmente, os indicadores básicos da saúde física dos jovens estudantes têm diminuído de forma completa. Essa circunstância tornou a saúde física dos adolescentes e a melhoria da qualidade dos jovens atletas um ponto-chave na educação física direcionada aos adolescentes. Objetivo: Investigar o efeito do treinamento intermitente de alta intensidade em jovens atletas. Métodos: 24 adolescentes realizaram 10 treinos intermitentes de alta intensidade, com duração de um mês, todos os índices pré e pós-treino dos atletas foram coletados e comparados. Resultados: Os resultados do exame físico de atletas do sexo masculino e feminino melhoraram em certa medida (a pressão arterial dos atletas flutuou durante as 10 sessões de treinamento, aumentando ligeiramente, e a variabilidade da frequência cardíaca aumentou consideravelmente ($P < 0,05$). Conclusão: O treinamento intermitente de alta intensidade tem um bom efeito na promoção da saúde nos jovens atletas, podendo melhorar efetivamente sua função física e desempenho competitivo. Professores de educação física e atletas estudantes devem realizar treinamentos relevantes. Além disso, esse método de treinamento também se encaixa na situação atual da vida de aprendizagem dos alunos do ensino médio.* ***Nível de evidência II; Estudos terapêuticos - investigação dos desfechos do tratamento.***

***Descritores:*** *Adolescente; Atletas; Treinamento Intervalado de Alta Intensidade; Avaliação de Resultado de Ações Preventivas.*

## *RESUMEN*

*Introducción: El Comité Central del CPC y el Consejo de Estado han puesto de relieve que en la actualidad los indicadores básicos de salud física de los jóvenes estudiantes han disminuido completamente. Esta circunstancia hizo que la salud física de los adolescentes y la mejora de la calidad de los jóvenes deportistas fuera un punto clave en la educación física dirigida a los adolescentes. Objetivo: Investigar el efecto del entrenamiento intermitente de alta intensidad en atletas jóvenes. Métodos: 24 adolescentes realizaron 10 sesiones de entrenamiento intermitente de alta intensidad de un mes de duración, se recogieron y compararon los índices de todos los atletas antes y después del entrenamiento. Resultados: Los resultados de la exploración física de los atletas masculinos y femeninos mejoraron en cierta medida (la presión arterial de los atletas fluctuó durante las 10 sesiones de entrenamiento, aumentando ligeramente, y la variabilidad de la frecuencia cardíaca aumentó considerablemente ($P < 0,05$). Conclusión: El entrenamiento intermitente de alta intensidad tiene un buen efecto en la promoción de la salud en los atletas jóvenes, y puede mejorar eficazmente su función física y su rendimiento competitivo. Los profesores de educación física y los alumnos deportistas deben realizar la formación pertinente. Además, este método de formación también se ajusta a la situación actual de la vida de aprendizaje de los estudiantes de secundaria.* ***Nivel de evidencia II; Estudios terapêuticos - investigación de los resultados del tratamiento.***

***Descriptores:*** *Adolescente; Atletas; Entrenamiento de Intervalos de Alta Intensidad; Evaluación de Resultados de Acciones Preventivas.*



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## INTRODUCTION

In recent years, the deterioration of physical health of contemporary high school students has become the focus of social attention. Today, with great learning pressure, high school students must have a strong physique if they want to achieve certain success in study and life and lay a good foundation for their own development.[1] The CPC Central Committee and the State Council stressed that at present, the basic indicators of young students' physical health have declined in an all-round way. By searching and reading a large number of literature, this paper broadly defines high-intensity intermittent training as short to medium-term high-intensity training, and the exercise intensity needs to exceed the anaerobic threshold, and the training time is proposed to be 10s-5min.[2] The interval time shall be set in the training room, which can be divided into low-intensity training or complete interval, and shall be set as the form of incomplete recovery. Because teenagers are in an important stage of life, they have great learning pressure and cannot effectively ensure their exercise time. Unlike traditional training, high-intensity interval training has low frequency, short time and rich forms. Therefore, it is sought after by the majority of students and has become an easily accepted and effective training method.[3] Previously, this training method was commonly used in the training process of professional athletes, and with the deepening of research, it has gradually been accepted by the public and become a reasonable form of choice.[4]

In order to further explore the impact of high-intensity intermittent training on young athletes, this paper takes senior high school sports majors as the research object, discusses the changes of physical test results and cardiopulmonary function of athletes of different genders before and after high-intensity intermittent training, and further analyzes the training methods of teenagers. The results can be used in the training of young athletes and can also be extended to the daily training process of ordinary senior high school students. So as to promote the improvement of competitive performance of high school young athletes and the enhancement of high school students' physique.[5]

## METHOD

### Selection of research objects

On the premise of fully informing the experimental needs and completely voluntary, 13 male sports specialty students and 14 female sports specialty students were recruited as the research objects. Through the screening of the research objects and some samples falling off in the process of exercise, the research objects who finally participated in the experiment and recorded were 12 boys and 12 girls. The study and all the participants were reviewed and approved by Ethics Committee of Beijing Sport University (NO. 2018BSUZZ04).

### Experimental design

The duration of this experiment is one month. A total of 10 high--intensity interval training is carried out, with each exercise duration of 60 minutes, including 15 minutes of warm-up exercise, 30 minutes of high-intensity interval training and 15 minutes of stretching and relaxation exercise. Among them, high-intensity advanced training includes 8 actions, 8 actions are a large group, and there are three minutes of rest time between large groups, and each action lasts for 20 seconds, there is a 10 second break between actions.

In order to reduce the interference of other factors as much as possible, this paper adopts the method of comparison before and after the group, compares the effects of the same group of athletes, compares the data measured before the experiment with the data measured after the experiment, excludes the samples of athletes who have not completed all training or the influence of interference in physiological period, and finally obtains the research results of 12 male athletes and 12 female athletes.

## RESULTS

### Comparison of physical test results before and after high-intensity interval training

It can be seen from Table 1 that the physical test results of girls before and after high-intensity intermittent training have changed to some extent, in which the BMI results have changed from (20.063 ± 3.396) kg / $m^2$ before training to (19.292 ± 2.313) kg / $m^2$ after training, and $P < 0.01$ shows that there is a very significant difference; The results of upper limb strength changed from (27.354 ± 9.180) kg before training to (33.394 ± 6.736) kg after training, and $P < 0.01$ showed that there was a very significant difference; The results of lower limb strength changed from (1046.817 ± 122.790) w before training to (1174.352) w after training, and $P < 0.01$ showed that there was a very significant difference; The results of vertical jump height changed from (32.783 ± 6.054) cm before training to (37.005 ± 3.311) cm after training, and $P < 0.01$ showed that there was a very significant difference; The results of 30m ranged from (4.611 ± 0.692) s before training to (4.414 ± 0.767) s after training, and $0.01 < p < 0.05$; The results of step test ranged from (58.008 ± 2.937) before training to (63.001 ± 2.654) after training, and $0.01 < p < 0.05$, indicating that there was a significant difference; The forward flexion performance of sitting body increased slightly from (13.841 ± 7.201) cm before training to (14.204 ± 8.512) cm after training, but there was no significant difference ($P > 0.05$). Therefore, it can be seen that high-intensity intermittent training can improve the performance of physical examination in all aspects, and the effects are different. Therefore, high-intensity intermittent training can comprehensively exercise the physical quality of girls.

The impact of high-intensity interval training on boys is shown in Table 2. From Table 2, it can be seen that the strength performance of lower limbs ranges from (1392.692 ± 206.433) w before training to (1539.212 ± 246.625) w after training, and $P < 0.01$ shows that there is a very significant difference; The results of vertical jump height changed from (52.011 ± 10.554) cm before training to (58.156 ± 10.637) cm after training, and $P < 0.01$ showed that there was a very significant difference; BMI scores ranged from (20.482 ± 1.939) kg / $m^2$ before training to (19.583 ± 1.497) kg / $m^2$ after training, and $0.01 < p < 0.05$, indicating significant differences; The results of step test ranged from (61.096 ± 1.860) before training to (61.807 ± 2.007) after training, and $0.01 < p <$

**Table 1.** Comparison of physical test results of girls before and after high-intensity interval training.

| Option | Before training | After training | T | P |
|---|---|---|---|---|
| BMI | 20.063 ±3.396 | 19.292 ±2.313 | 4.7248 | 0.0009 |
| Upper limb strength | 27.354 ±9.180 | 33.394 ±6.736 | -3.6366 | 0.0060 |
| Lower limb strength | 1,046.817 ±122.790 | 1174.352 ±84.976 | -2.8821 | 0.0008 |
| Vertical jum | 32.783 ±6.054 | 37.005 ±3.311 | -5.5420 | 0.0000 |
| Sitting body | 13.841 ±7.201 | 14.204 ±8.512 | -2.2617 | 0.0506 |
| 30m score | 4.611 ±0.692 | 4.414 ±0.767 | 3.2221 | 0.0109 |
| Stairs test | 58.008 ±2.937 | 63.001 ±2.654 | -2.7085 | 0.0250 |

**Table 2.** Comparison of physical test results of boys before and after high-intensity interval training.

| Option | Before training | After training | T | P |
|---|---|---|---|---|
| BMI | 20.482 ±1.939 | 19.583 ±1.497 | 2.5083 | 0.0345 |
| Upper limb strength | 65.360 ±12.974 | 67.628 ±11.331 | -1.4805 | 0.1698 |
| Lower limb strength | 1392.692 ±206.433 | 1539.212 ±246.625 | -5.7415 | 0.0000 |
| Vertical jum | 52.011 ±10.554 | 58.156 ±10.637 | -5.7108 | 0.0000 |
| Sitting body | 13.427 ±8.550 | 14.304 ±8.976 | 0.2618 | 0.7906 |
| 30m score | 3.937 ±0.327 | 3.892 ±0.966 | 1.8269 | 0.0997 |
| Stairs test | 61.096 ±1.860 | 61.807 ±2.007 | -2.4577 | 0.0384 |

0.05, indicating that there was a significant difference; The results of upper limb strength changed from (65.360 ± 12.974) kg before training to (67.628 ± 11.3312) kg after training, and P > 0.05 showed that there was no significant difference. The results of forward flexion in sitting position ranged from (13.427 ± 8.550) cm before training to (14.304 ± 8.9762) cm after training, and P > 0.05 showed that there was no significant difference. The 30m score changed from (3.937 ± 0.327) s before training to (3.892 ± 0.9662) s after training, and P > 0.05 showed that there was no significant difference. Therefore, high-intensity training can improve the comprehensive quality of male and female athletes, so it is worth promoting as an effective training method

## Comparison of cardiopulmonary function before and after high intensity interval training

The change of heart rate of young athletes in the process of high-intensity intermittent training is shown in Figure 1. It can be seen from Figure 1 that in the process of 10 training, the heart rate of young athletes shows a fluctuating state, and the change range is relatively small, in which the average heart rate is almost the same before and after and remains in a stable state as a whole. The minimum heart rate shows a stable and slightly increased state, and the maximum heart rate also fluctuates slightly forward. Therefore, it can be seen that the effect of high-intensity intermittent training on the heart rate of teenagers shows a slight increase.

Heart rate variability is also an important factor affecting the sports quality of young athletes. It can be seen from Table 3 that before and after sports training, sdsd index changes from (66.342 ± 13.975) ms before training to (87.791 ± 17.111) ms after training, and P < 0.01 shows that there is a very significant difference; RMSSD index changed from (53.464 ± 10.493) ms before training to (65.195 ± 12.852) ms after training, and 0.01 < p < 0.05, indicating that there was a significant difference; TP index changed from (788.935 ± 352.024) MS2 before training to (1272.337 ± 521.929) MS2 after training, and 0.01 < p < 0.05, indicating that there was a significant difference; HF index changed from (366.504 ± 176.847) MS2 before training to (705.236 ± 404.165) MS2 after training, and 0.01 < p < 0.05; SDNN index changed from (54.890 ± 16.931) ms before training to (65.102 ± 9.099) ms after training, and P > 0.05 showed that there was no significant difference. LF index changed from (279.818 ± 169.544) MS2 before training to (406.824 ± 226.162) MS2 after training, and P > 0.05 showed that there was no significant difference. This shows that 10 times of high-intensity interval training can effectively improve the heart rate variability of young athletes, so as to lay a certain foundation for the improvement of their sports level.

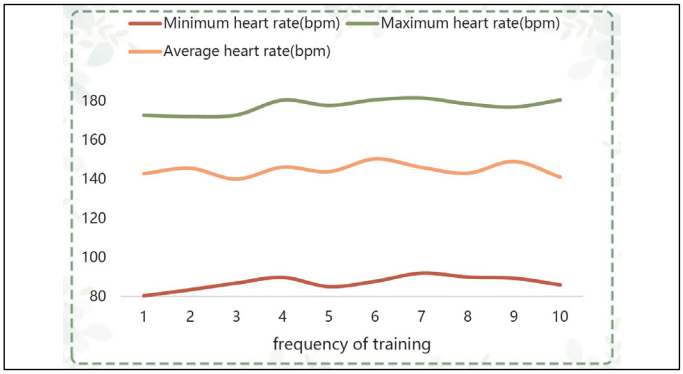


**Figure 1.** Changes of center rate in high-intensity interval training of young athletes.

**Table 3.** Analysis of heart rate variability of young athletes before and after high-intensity interval training.

| Option | Before training | After training | T | P |
|---|---|---|---|---|
| SDNN (MS) | 54.890 ±16.931 | 65.102 ±9.099 | 1.5644 | 0.2002 |
| RMSSD (MS) | 53.464 ±10.493 | 65.195 ±12.852 | 2.7075 | 0.0212 |
| SDSD (MS) | 66.342 ±13.975 | 87.791 ±17.111 | 3.1495 | 0.0089 |
| TP (MS2) | 788.935 ±352.024 | 1272.337 ±521.929 | 2.3364 | 0.0415 |
| HF (MS2) | 366.504 ±176.847 | 705.236 ±404.165 | 2.6501 | 0.0212 |
| LF (MS2) | 279.818 ±169.544 | 406.824 ±226.162 | 1.4670 | 0.1727 |

As shown in Table 4, in the whole body HIIT group, the main part adopts 8 actions: pushing up and down to smash the Bosu ball, fully lifting and pulling the elastic belt, hand and foot prone simultaneous sliding board, combined with the movement of the climbing machine, oblique downward side pulling the elastic belt, prone up and down movement, prone lateral movement, Bobby jump and so on.

**Table 4.** Full height intensity interval training method.

| Training action | Exercise intensity (kg) | Exercise time (s) | Rest time (s) | Rest room (s) | Group number |
|---|---|---|---|---|---|
| Push down the BOSU ball | Bosu ball weight | 20 | 10 | 3 | 3 |
| Full tale bullet | 25/35 /45 | 20 | 10 | 3 | 3 |
| Hand-foot push-up coiling plate | Athlete self weight | 20 | 10 | 3 | 3 |
| Combined with climbing machine | Athlete self weight | 20 | 10 | 3 | 3 |
| Sliding force belt | 25/35 /45 | 20 | 10 | 3 | 3 |
| Push up movement | Athlete self weight | 20 | 10 | 3 | 3 |
| Propide side movement | Athlete self weight | 20 | 10 | 3 | 3 |
| Bobi jump | Athlete self weight | 20 | 10 | 3 | 3 |

## DISCUSSION

At the initial stage of training, the medium intensity of traditional training is enough to meet the requirements of students for aerobic endurance. However, as students' cardiopulmonary function and muscle endurance gradually adapt to the medium intensity, if the training intensity is less than 130 times / minute, the training process will lead to the reduction of their heart blood volume and insufficient body oxygen demand, which makes the training effect unsatisfactory, so it is necessary to increase the training intensity. Because of its high intensity, high intensity training can make up for the deficiency that medium intensity training cannot meet the physical needs. During high-intensity training, the heart rate during physical exercise is 160-185 beats / min. High intensity training can improve the blood transfusion and oxygen supply of the heart within 10-30 seconds after training. Some boys have challenging ideas about high-intensity training programs, which is in line with the educational concept of taking students as the main body and cultivating students' personality and subjective initiative. The intensity of adolescent aerobic endurance quality has a positive impact on the development of adolescent training. However, on the other hand, because high-intensity training is designed as a form of high-intensity interval training, it will become a double-edged sword. In the process of high-intensity training, if the training intensity is not well controlled, resulting in students' heart rate higher than 190 beats / min, it will make their heart diastolic filling insufficient, which will lead to the reduction of cardiac blood output, which is extremely unfavorable to the improvement of aerobic endurance.

Combined with the relevant research data and problems in this experiment, it can be found that there are potential safety hazards in the implementation of high-intensity intermittent training. High intensity training can greatly stimulate students' heart function, but there are also safety problems such as insufficient blood supply to the heart. High intensity exercise increases the intensity of exercise and increases the potential heart risk caused by exercise. At present, most of the known studies on the

heart risk of high-intensity exercise are retrospective studies, which do not include the difference of heart risk between different forms of high-intensity exercise, so it is difficult to clearly show the relationship between them.

## CONCLUSION

From the research results of this paper, it can be seen that high--intensity interval training plays a certain role in improving athletes' comprehensive physical test results, improving heart rate and heart rate variability. Therefore, high-intensity interval training is worthy to be widely used in the training process of high school young athletes. In addition, high-intensity intermittent training has good effects such as short time, high efficiency and easy adherence, which is also very consistent with the actual situation of high school students' study and life. Therefore, physical education teachers can also improve it to a certain extent and widely promote it in high school youth physical education, so as to improve the physical level of young athletes and ordinary high school students, so as to improve the overall physical function of high school students, Improve the physical quality of the people.


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