

# IMPACTS OF RESISTANCE TRAINING ON PHYSICAL FITNESS AND INJURY PREVENTION IN CHILDREN AND ADOLESCENTS



ORIGINAL ARTICLE  
ARTIGO ORIGINAL  
ARTÍCULO ORIGINAL

IMPACTOS DO TREINAMENTO DE RESISTÊNCIA SOB A APTIDÃO FÍSICA E PREVENÇÃO DE LESÕES EM CRIANÇAS E ADOLESCENTES

IMPACTOS DEL ENTRENAMIENTO DE RESISTENCIA EN LA APTITUD FÍSICA Y LA PREVENCIÓN DE LESIONES EN NIÑOS Y ADOLESCENTES

Wang Hui<sup>1</sup>   
(Physical Education Professional)

1. Shandong Institute of Petroleum and Chemical Technology, Dongying, Shandong, China.

## Correspondence:

Wang Hui  
Shandong, China, 257000.  
wanghui678906@163.com

## ABSTRACT

**Introduction:** An adequate physical intervention program can improve the physical level of adolescents, promoting their interest in sports learning and socialization, factors that indirectly contribute to academic performance. Despite having a positive impact on athlete performance, cardiopulmonary resistance training has received few studies related to its benefits in children and adolescents. **Objective:** Explore the effect of resistance training on the physical fitness of children and adolescents and the prevention of their sports injuries. **Methods:** The statistical method was used in a situational analysis of injuries in different sports of 455 young people. In a second moment, 20 volunteers divided into groups by sex were submitted to resistance training exercises involving aerobic (30 minutes) and anaerobic (15 minutes) activity, under 45 minutes daily, three times a week, for ten weeks. Pertinent data were collected before, during, and after the intervention. They were submitted for analysis and consideration and performed statistical treatment on the data. **Results:** The frequency of sports injuries in adolescents was high, especially the mild injuries related to the characteristics of adolescents. Under the same intensity of resistance training, there was an improvement in running performance. There was a significant improvement in lung capacity, with relatively small differences between males and females. **Conclusion:** Resistance training can effectively improve the fitness level of children and adolescents, and its promotion is strongly recommended. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Training, Endurance; Adolescent; Primary Prevention.

## RESUMO

**Introdução:** Um programa de intervenção física adequado pode melhorar o nível físico dos adolescentes, promovendo seu interesse na aprendizagem esportiva e socialização, fatores que contribuem indiretamente para o desempenho acadêmico. O treinamento de resistência cardiopulmonar, apesar de impactar positivamente na performance de atletas, recebeu poucos estudos relacionados aos benefícios desempenhados em crianças e adolescentes. **Objetivo:** Explorar o efeito do treinamento de resistência sob a aptidão física de crianças e adolescentes, bem como na prevenção de suas lesões esportivas. **Métodos:** O método estatístico foi empregado na análise situacional de lesões em diferentes esportes de 455 jovens. Num segundo momento, 20 voluntários divididos em grupos por sexo foram submetidos à exercícios de treinamento de resistência envolvendo atividade aeróbica (30 minutos) e anaeróbica (15 minutos), sob 45 minutos diários, três vezes por semana, durante 10 semanas. Os dados pertinentes foram coletados antes, durante e após a intervenção. Efetuada a estatística de tratamento nos dados, foram submetidos para análise e consideração. **Resultados:** A frequência das lesões esportivas em adolescentes foi alta, principalmente as lesões leves, relacionadas às características dos adolescentes. Sob a mesma intensidade do treinamento de resistência, houve melhora no desempenho da corrida. Houve melhora significativa na capacidade pulmonar, com diferenças relativamente pequenas entre homens e mulheres. **Conclusão:** O treinamento de resistência pode melhorar efetivamente o nível físico de crianças e adolescentes, e sua promoção é fortemente recomendada. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Treinamento de Resistência; Adolescente; Prevenção Primária.

## RESUMEN

**Introducción:** Un adecuado programa de intervención física puede mejorar el nivel físico de los adolescentes, promoviendo su interés por el aprendizaje deportivo y la socialización, factores que contribuyen indirectamente al rendimiento académico. El entrenamiento de resistencia cardiopulmonar, a pesar de tener un impacto positivo en el rendimiento de los deportistas, ha recibido pocos estudios relacionados con los beneficios realizados en niños y adolescentes. **Objetivo:** Explorar el efecto del entrenamiento de resistencia en la condición física de niños y adolescentes, así como en la prevención de sus lesiones deportivas. **Métodos:** Se empleó el método estadístico en el análisis



situacional de las lesiones en diferentes deportes de 455 jóvenes. En un segundo momento, 20 voluntarios divididos en grupos por sexo fueron sometidos a ejercicios de entrenamiento de resistencia que incluían actividad aeróbica (30 minutos) y anaeróbica (15 minutos), bajo 45 minutos diarios, tres veces por semana, durante 10 semanas. Los datos pertinentes se recogieron antes, durante y después de la intervención. Realizado el tratamiento estadístico de los datos, éstos fueron sometidos a análisis y consideración. Resultados: La frecuencia de las lesiones deportivas en los adolescentes fue alta, principalmente las lesiones leves, relacionadas con las características de los adolescentes. Con la misma intensidad de entrenamiento de resistencia, se produjo una mejora en el rendimiento de la carrera. Hubo una mejora significativa en la capacidad pulmonar, con diferencias relativamente pequeñas entre hombres y mujeres. Conclusión: El entrenamiento de resistencia puede mejorar eficazmente el nivel físico de los niños y adolescentes, y su promoción es muy recomendable. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Entrenamiento de Resistencia; Adolescente; Prevención Primaria.

DOI: [http://dx.doi.org/10.1590/1517-8692202329012022\\_0165](http://dx.doi.org/10.1590/1517-8692202329012022_0165)

Article received on 03/15/2022 accepted on 05/31/2022

## INTRODUCTION

Different from some professional athletes, teenagers and children are still in a confused state in sports training. Therefore, when carrying out endurance training for teenagers and children, we must scientifically match the intensity of sports training and adjust teenagers' sports skills in time to prevent sports injury. The research shows that on the basis of fully understanding the needs of teenagers and their own psychological situation, designing an appropriate physical improvement intervention program can not only improve the physical level of teenagers, but also promote their sports interest, learning interest, social interest and so on, indirectly improve their academic performance, so as to achieve the purpose of common development in many aspects. The researchers carried out cardiopulmonary endurance training by carrying out appropriate physical load exercise for men and women. The research shows that the cardiopulmonary endurance between the two groups has improved, and accompanied by the decline of body fat rate.<sup>1</sup>

Among them, the decline of body fat rate of girls is more obvious than that of boys, which shows that endurance training can not only improve the cardiopulmonary function of teenagers. It can also improve its body shape. In terms of sports injury prevention, some researchers analyzed the sports injury of teenagers and proposed that at present, the probability of sports injury of male teenagers is 33% ~ 55%, and the probability of sports injury of female teenagers is 19% ~ 59%, which is also related to the daily living habits and sports habits of boys and girls. After fully analyzing the sports injuries existing in the current sports process of teenagers, researchers put forward the causes of sports training injuries of teenagers from the aspects of physiology, psychology and technology, and put forward some prevention strategies.<sup>2</sup> Through the research, this paper finds that it is easy for teenagers to have sports injuries if they do not carry out certain sports injury prevention in the process of teenagers' training. These injuries not only affect the current physical condition of teenagers, but also lead to the occurrence of diseases such as arthritis or pain, which will have a certain impact on the quality of life of teenagers in the future. In addition, some sports injuries will also lead to teenagers' fear of sports, which is not conducive to the development of their sports health career in the future.<sup>3</sup>

## METHOD

### Data statistics

In order to design a more suitable sports program for teenagers, we must first analyze the actual situation of sports training. Therefore, this paper selects the students who participate in various sports interest groups in grade one and grade two of several middle schools in a city, aged 12 ~ 15. The study and all the participants were reviewed and

approved by Ethics Committee of Shandong Institute of Petroleum and Chemical Technology (NO. 202015562). Because the teenagers at this stage do not have a clear understanding of the situation of sports injury, when investigating the situation of sports injury, they do not choose the questionnaire survey method, but the statistical method. With the help of physical education teachers, they analyze the injury situation and injury parts of teenagers in different sports. A total of 455 people, including sports injury. The total number of people including serious and minor cases is 197.

### Experimental design

Cardiopulmonary endurance training includes aerobic endurance and anaerobic endurance. Because there are certain differences between boys' and girls' physique, the grouping of this experiment is based on boys' group and girls' group. The way is to compare the data before and after the experiment. Firstly, the subjects were divided into male and female groups, with 10 students in each group and 20 students in total. They were trained in cardiopulmonary endurance. Due to the limitations of the site and experimental conditions, the methods selected in this paper are simple and easy. Aerobic endurance exercise is a 20-meter round-trip run, which can be carried out under a certain music rhythm, so as to enhance students' exercise coordination and improve their cardiopulmonary function. The training method of anaerobic endurance is Endurance Games and so on. Through the design of the game, participants can complete relevant training in the process of entertainment, so as to increase interest and enthusiasm of sports training. This cardiopulmonary endurance training is mainly aerobic endurance, supplemented by anaerobic endurance, in which aerobic exercise is maintained at about 30 minutes and anaerobic endurance is about 15 minutes. The overall training duration is maintained within 45 minutes of a class, three times a week, and the training cycle is 10 weeks.

## RESULTS

### Analysis of teenagers' sports injury and prevention awareness

There are many factors for teenagers' sports injury, but teenagers' own prevention consciousness and PE Teachers' prevention consciousness undoubtedly have a great influence. Therefore, this paper makes statistics and Analysis on Teenagers' sports injury, and investigates the attitude of PE teachers.

As shown in Figure 1, the statistical results of adolescent sports injuries are shown. Among the 221 boys, the number of sports injuries is 104, accounting for 47.06%. Among the 234 girls, the number of sports injuries was 93, accounting for 39.47%. In terms of the gender proportion of overall sports injury, boys account for 54% and girls account for 46%.

This shows that teenagers are not proficient in their own sports skills and lack of sports experience, so they have a very high proportion of sports injuries, and boys have a higher proportion of sports injuries than girls because of their relatively large amount of activities and high risk coefficient of activities.

Figure 2 shows the statistics and arrangement of the common sports injury parts of teenagers at present. It can be seen that the highest injury part is the lower limbs, including the feet, accounting for 34.25%; The second is the upper limb, including the hand, accounting for 29.84%. It can be seen that for teenagers, because their motor skills are not fully mastered, they often subconsciously use their limbs for defense in the process of falling, so the proportion of limb injury is very high. But relatively speaking, the injury of limbs is not serious, mostly bruises, sprains, strains and other injuries, and very few will have fractures. It can be seen from the whole of Figure 2 that although the sports injury of teenagers is high, it is often some light rubbing injury, which has little impact on teenagers. At the same time, due to the lively nature of teenagers and their unfamiliar sports skills, sports injury is a relatively normal phenomenon.<sup>4</sup>

As shown in Figure 3, the types of sports injuries of teenagers are shown. The statistical method is the number of injuries / total number of people, so as to obtain the proportion of sports injury types. It can be seen from the statistics that the injury type with the highest proportion at present is strain, accounting for 59.6%, followed by sprain, accounting for 39.3%, abrasion again, accounting for 32.6%, and contusion, accounting for 27.9%. It can be seen from the previous four that the severity of adolescent sports injury types is not high. Combined with the current growth experience of adolescents in the exploration stage, this type of sports injury is normal. Neither physical education teachers nor students'

parents show too much tension. However, for adolescents, the proportion of relatively serious sports injuries, such as fractures, tears, dislocations, periostitis and so on, although the overall proportion is relatively low, the proportion in adolescent sports groups also shows a trend worthy of attention. Therefore, physical education teachers should further prevent teenagers' sports injuries and prevent some more serious sports injuries, so as to achieve the purpose of scientific training.

It can be seen from table 1 that whether in antagonistic or non-antagonistic projects, the injury most valued by physical education teachers is the spine, with a score of more than 4 points, which belongs to the scope of great attention, which is also related to the irreversibility and severity of spinal injury. In addition, in antagonistic projects, physical education teachers pay more attention to the injury parts of head and face, upper limbs and waist and abdomen. In non-antagonistic projects, physical education teachers pay more attention to the parts of upper limbs, lower limbs and waist and abdomen, of which the proportion of upper limbs and waist and abdomen is high in both aspects. Through the communication with physical education teachers, it can be seen that students' hands need all kinds of dexterous operations. Therefore, in the process of training, if sports injury occurs to the upper limbs, the consequences are more serious than those of the lower limbs, and parents pay more attention to it.

### Analysis of the impact of endurance training on Teenagers' body shape

In the first, fifth and tenth weeks of the experiment, the body shape data of the experimental subjects were collected and sorted out respectively, as shown in Table 2 and 3.

As shown in Table 2, the effect of endurance training on boys' body shape indexes is shown. In terms of height, the height of boys increased slightly with the extension of training time,  $P > 0.05$ , indicating that there was no significant difference, which was also related to the fact that boys

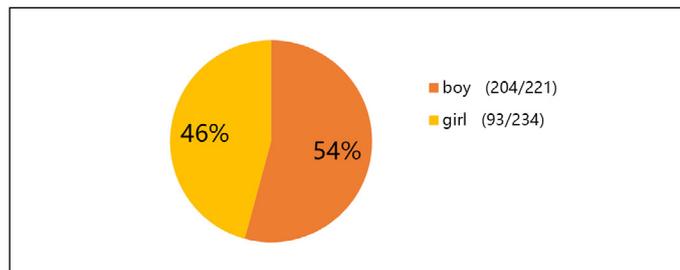


Figure 1. Sex proportion of adolescent sports injury.

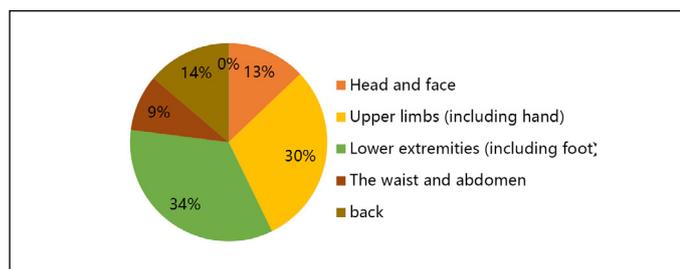


Figure 2. Location of adolescent sports injury.

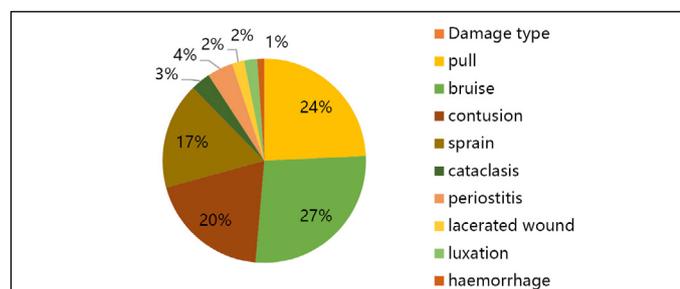


Figure 3. Types of adolescent sports injury.

Table 1. Score of physical education teachers' attention to adolescent sports injury parts.

Project type	Injured part	Mean	SD	P
Antagonistic project	Headside	2.912	1.414	0.09
	Upper limbs (including hand)	2.816	1.395	0.015
	Lower limbs (inclusion)	2.357	1.204	0.000
	Waist belly	2.521	1.104	0.000
	Back	1.512	0.917	0.000
	spine	4.542	0.612	0.000
Non-antique project	Headside	2.028	1.024	0.314
	Upper limb	2.942	1.404	0.439
	Lower extremity	2.898	1.227	0.242
	Waist belly	2.662	1.338	0.194
	Back	2.515	0.998	0.012
	Spine	4.294	1.107	0.005

Table 2. Effects of endurance training on body shape indexes of boys.

Option	1st week	5th week	10th week	P
Height	155.358±8.17	155.515±8.15	155.894±8.09	0.209
Weight	43.752±6.651	43.345±6.434	43.132±6.221	0.0478
Waistline	67.015±6.451	65.174±5.145	64.201±4.141	0.0143
BMI	20.43±1.41	20.38±1.40	20.21±1.29	0.0147

Table 3. Effect of endurance training on body shape indexes of girls.

Option	1st week	5th week	10th week	P
Height	152.324±4.167	152.663±4.52	152.829±4.152	0.132
Weight	45.676±4.785	44.518±4.215	44.041±4.123	0.0142
Waistline	58.532±6.355	57.194±5.897	56.220±5.468	0.0136
BMI	19.649±1.352	19.134±1.331	18.184±1.350	0.0119

were still in the growth cycle. There was a slight decline in body weight and a slow decline in BMI index ( $P < 0.05$ ), indicating that there was a significant difference. For boys, the waist circumference changed the most, from  $(67.015 \pm 6.451)$  cm in the first week to  $(65.174 \pm 5.145)$  cm in the fifth week and then to  $(64.201 \pm 4.141)$  cm in the tenth week,  $P < 0.05$ , indicating that there was a significant difference, indicating that endurance training had a good effect on boys' body shape, reducing boys' waist circumference and making their body shape more symmetrical ( $P < 0.05$ ).

Through a comprehensive analysis of Table 2 and 3, it can be seen that endurance training has more obvious changes in girls' body weight and BMI index. The reason may be that girls' daily exercise intensity is less than boys. Therefore, when carrying out the same endurance training for 10 weeks, boys' adaptability to sports is higher than girls, so the effect of relevant sports training on girls is more significant. But on the whole, endurance training can promote the reduction of body weight, BMI index and waist circumference, so as to make the body healthier and more symmetrical.<sup>5</sup>

## DISCUSSION

Teenagers are in a critical period of growth and development. Their endurance training must choose appropriate methods according to the actual situation. In adolescence, because their respiratory system and circulatory system are not yet mature, the cardiovascular oxygen supply capacity of adolescents is relatively poor compared with adults, the blood oxygen saturation and maximum oxygen uptake are still in a low stage, and the endurance quality is lower than that of adults.<sup>6</sup> In this period, although the effect of endurance training for teenagers is not as significant as that of adults, it can still have a certain effect on their endurance.<sup>7</sup>

For teenagers, first of all, they should have a clear awareness of avoidance. For example, in the process of sports training, they should timely

follow the guidance of teachers, standardize their actions, and do not deliberately do some dangerous actions. For example, in the process of sports training, do not climb and fight at will, so as to reduce unnecessary sports injuries. The warm-up activities at the beginning of sports should be completed actively and seriously, and the body should be fully activated to prevent sports injury caused by insufficient preparation activities. When you think your state is improper during exercise, you should report to the physical education teacher in time. You must not exercise in a tired or uncomfortable state to prevent sports injury caused by poor state. For the necessary protective equipment in the process of some sports, teenagers should have the awareness of actively wearing protective equipment, and should not be lazy or rash to prevent sports injuries caused by improper self-defense.<sup>8</sup>

## CONCLUSION

From the research of this paper, it can be seen that adolescent endurance training can significantly improve their physique, promote their physical and mental development, enhance their cardiopulmonary ability and exercise ability, make their physique more symmetrical, and have a good solution to the current problems such as the deterioration of adolescent obesity physique. In the process of sports, we should fully select the appropriate sports plan according to the actual stage of teenagers' physical and mental development, reduce sports injuries as much as possible, and create an orderly and safe sports environment for teenagers, so as to improve teenagers' endurance quality and promote their physical and mental health development.

---

The author declare no potential conflict of interest related to this article

---

---

**AUTHORS' CONTRIBUTIONS:** Every author has made an important contribution to this manuscript. WH: writing and execution.

---

## REFERENCES

1. World Health Organization (WHO) [https://www.who.int/]. Noncommunicable diseases: Childhood overweight and obesity. 2018. [Access on 2021 Oct 19]. Available from: <https://www.who.int/news-room/q-a-detail/noncommunicable-diseases-childhood-overweight-and-obesity>.
2. Rodriguez-Ayllon M, Cadenas-Sanchez C, Esteban-Cornejo I, Migueles JH, Mora-Gonzalez J, Henriksson P, et al. Physical fitness and psychological health in overweight/obese children: a cross-sectional study from the ActiveBrains project. *J Sci Med Sport*. 2018;21(2):179-84.
3. Léger LA, Mercier D, Gadoury C, Lambert J. The multistage 20 metre shuttle run test for aerobic fitness *J Sports Sci*. 1988;6(2):93-101.
4. McIntosh AS, McCrory P, Finch CF, Wolfe R. Head, face and neck injury in youth rugby: Incidence and risk factors. *Br J Sports Med*. 2010;44(3):188-93.
5. Brenner JS, Council on Sports Medicine and Fitness. Overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics*. 2007;119(6):1242-5.
6. Bergman BC, Butterfield GE, Wolfel EE, Lopaschuk GD, Casazza GA, Horning MA, et al. Muscle net glucose uptake and glucose kinetics after endurance training in men. *Am J Physiol*. 1999;277(1):E81-92.
7. Caine D, Maffulli N, Caine C. Epidemiology of injury in child and adolescent sports: injury rates, risk factors, and prevention. *Clin Sports Med*. 2008;27(1):19-50.
8. Rechel JA, Yard EE, Comstock RD. An epidemiologic comparison of high school sports injuries sustained in practice and competition. *J Athl Train*. 2008;43(2):197-204.