

# PHYSICAL FITNESS OF ATHLETES UNDER ENDURANCE TRAINING



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APTIDÃO FÍSICA DOS ATLETAS SOB TREINAMENTO DE RESISTÊNCIA FÍSICA

APTITUD FÍSICA DE LOS ATLETAS BAJO ENTRENAMIENTO DE RESISTENCIA FÍSICA

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## ABSTRACT

**Introduction:** Athletes must have high sports skills and endurance to achieve good results in the field. Therefore, endurance training is very important among athletes. **Objective:** Explore the application of endurance training in teaching athletes physical fitness. **Methods:** In the form of a control experiment, 20 junior athletes were voluntary participants in this research. Divided into control and experimental groups, the control followed the usual training plan while the experimental group was added 1.5 hours of post-workout endurance training. Data was recorded and cataloged before and after the experiment. **Results:** Both endurance and routine training can improve the physical fitness of athletes. The improvement of endurance training was shown to be superior to traditional training methods. For the athletes in the experimental group, in the 6-week process, the three-sport indexes showed a fluctuating optimization and significantly improved overall compared to before the experiment. **Conclusion:** Endurance training has solid evidence of improving the physical fitness of athletes, including benefits related to ability and competitive performance. Therefore, further studies are recommended for its popularization. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Endurance Training; Physical Fitness; Physical Education and Training.

## RESUMO

**Introdução:** Os atletas devem ter altas habilidades esportivas e alta resistência para alcançar bons resultados em campo. Portanto, o treinamento de resistência física é muito importante entre os esportistas. **Objetivo:** Explorar a aplicação do treinamento de resistência física no ensino da aptidão física dos atletas. **Métodos:** Na forma de experimento de controle, 20 atletas juniores foram participantes voluntários dessa pesquisa. Divididos entre grupos controle e experimental, o controle seguiu o plano de treinamento habitual enquanto ao grupo experimental foram acrescentadas 1,5 horas de treinamento de resistência física pós-treino. Os dados foram registrados e catalogados antes e depois do experimento. **Resultados:** Tanto o treinamento de resistência física quanto o treinamento de rotina podem melhorar a aptidão física dos atletas. A melhoria do treinamento de resistência física mostrou-se superior aos métodos tradicionais de treinamento. Para os atletas do grupo experimental, no processo de 6 semanas, os três índices esportivos revelaram uma otimização flutuante e, de modo geral, foi significativamente aprimorado em comparação com o anterior ao experimento. **Conclusão:** O treinamento de resistência física tem sólidas evidências de melhorar a aptidão física dos atletas, incluindo os benefícios relacionados à capacidade e desempenho competitivo. Portanto, recomenda-se maiores estudos para a sua popularização. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Treinamento de Resistência; Aptidão Física; Educação Física e Treinamento.

## RESUMEN

**Introducción:** Los atletas deben tener altas capacidades deportivas y alta resistencia para alcanzar buenos resultados en campo. Por lo tanto, el entrenamiento de resistencia física es muy importante entre los atletas. **Objetivo:** Explorar la aplicación del entrenamiento de resistencia física en la enseñanza de la aptitud física de los atletas. **Métodos:** En forma de experimento de control, 20 atletas junior fueron participantes voluntarios en esta investigación. Divididos en grupos de control y experimental, el control siguió el plan de entrenamiento habitual, mientras que al grupo experimental se le añadió 1,5 horas de entrenamiento de resistencia después del entrenamiento. Los datos se registraron y catalogaron antes y después del experimento. **Resultados:** Tanto el entrenamiento de resistencia como el de rutina pueden mejorar la aptitud física de los deportistas. La mejora del entrenamiento de resistencia demostró ser superior a los métodos de entrenamiento tradicionales. Para los atletas del grupo experimental, en el proceso de 6 semanas, los tres índices deportivos mostraron una optimización fluctuante y, en general, mejoraron significativamente en comparación con el período previo al ensayo. **Conclusión:** El entrenamiento de resistencia tiene pruebas sólidas de que mejora la aptitud física de los atletas, incluidos los beneficios relacionados con la capacidad competitiva y el rendimiento. Por lo tanto, se recomienda realizar más estudios para su popularización. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Entrenamiento de Resistencia; Aptitud Física; Educación y Entrenamiento Físico.



## INTRODUCTION

Nowadays, due to the development of the times and the progress of science, higher requirements are put forward for the physical quality of athletes in sports. In daily training and teaching, while focusing on improving the physical quality of athletes, we can not ignore the sports endurance training of athletes.<sup>1,2</sup> Endurance is an important sign of an athlete's good or bad physical quality. It also represents the anti fatigue function of muscles in long-term exercise.<sup>3</sup> In daily training and teaching, endurance is divided into aerobic and anaerobic aspects. Aerobic endurance refers to the length of exercise time of human body and muscles in an oxygen rich environment. Anaerobic endurance is whether the body and muscle can persist in long-term exercise by providing energy through anaerobic metabolism.<sup>4</sup> In training, aerobic endurance and anaerobic endurance need to be carried out simultaneously, and these two training can achieve the effective improvement of physical skills, so as to achieve the purpose of training. In physical fitness training, the exercise of maintaining endurance can effectively improve the ability of body tissue to deliver oxygen, improve the utilization efficiency of muscle and bone for oxygen, and improve the regulation ability of motor nerve to the body during exercise.<sup>5</sup> Through aerobic and anaerobic endurance training, it can effectively improve athletes' physical quality and improve their physical exercise function, maintain a good exercise state, so as to improve athletes' competitive level. Endurance training can also improve athletes' anti fatigue ability and anti fatigue ability, which helps athletes adapt to long-term and high-intensity daily training, so as to improve their training efficiency.<sup>6</sup> In order to further analyze the effect of endurance training on Athletes' physical quality and explore the application of endurance training in athletes' physical quality teaching, this paper selects 16 athletes and divides them into experimental group and control group. Using the method of control experiment, this paper discusses the application of endurance training in athletes' physical quality teaching, so as to make some discussion on teaching optimization.

## METHOD

In this paper, 20 athletes are selected as the research object among the junior students majoring in basketball in Colleges and universities. The study and all the participants were reviewed and approved by Ethics Committee of Dalian Maritime University (NO.2020DLMU30-TC).

After six weeks of training, two athletes in the control group were separated from the sample due to various reasons. Therefore, two athletes in the experimental group were also randomly excluded. Finally, there were 8 athletes in the experimental group and 8 athletes in the control group.

This paper adopts the method of control experiment, in which the control group is carried out according to the existing basketball training method, and the experimental group replaces the one-hour basketball training method with the endurance training method. Conduct relevant training three times a week for 1.5 hours each time for a total of 6 weeks. The data of athletes were collected and compared before and after the experiment.

When analyzing the physical quality of athletes before and after endurance training, four indexes are selected, such as five consecutive run-up touch height, half "meter" movement, 30 second inclined board sit ups and 30 second 30kg clean and jerk. These four indicators not only belong to the basic skills in the process of basketball teaching, but also show the athletes' speed endurance and strength endurance, so they have a certain reference significance. Before and after the experiment, the relevant data were measured, compared and analyzed. When discussing the influence of endurance training on Athletes' sports skills, in order to

have a more intuitive understanding of the changes of sports skills, this paper selects the experimental group as the observation object. Before and after the experiment every week, the length change of 17 sideline turn back runs, the number of shots per minute, the layup time change of the whole court around the eight character dribble and other indicators are measured. A total of 7 groups of data are obtained, and the pictures are drawn by Excel software, So it is more convenient to analyze.

## RESULTS

### Effect of endurance training on Athletes' physical quality

Table 1 shows the analysis of athletes' physical quality before and after endurance training.

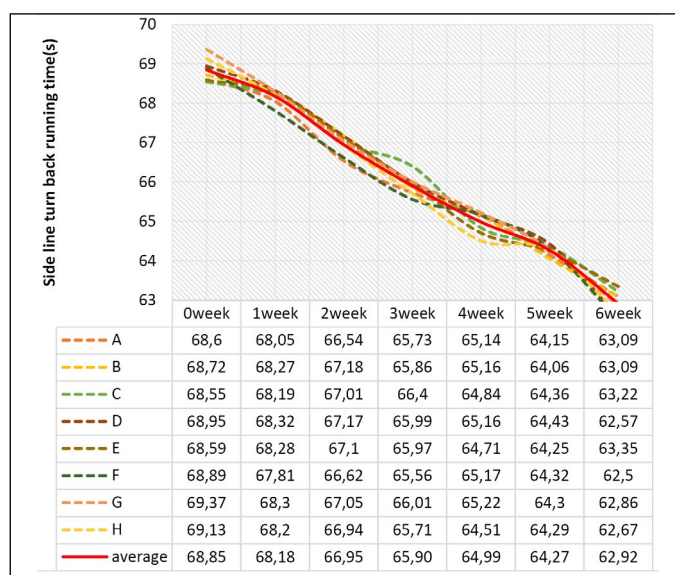
### Influence of endurance training on Athletes' sports skills

In order to analyze the effect of improving athletes' sports skills, this paper selects three indexes: the change of 17 sideline turn back runs, the change of the number of shots per minute, and the change of the layup time of the eight character dribble in the whole court. It is measured at seven time points before the experiment, after the experiment every week and after the experiment, and the corresponding pictures are drawn.

As shown in Figure 1, the length change of 17 sideline turn back runs in the six week training process of the experimental group is shown. As can be seen from Figure 1, the length of 17 sideline turn back runs of 8 athletes shows a fluctuating trend, but the overall trend is downward. The average value changes from 68.85 (s) → 68.18 (s) → 66.95 (s) → 65.90 (s) → 64.99 (s) → 64.27 (s) → 62.92 (s). The performance in the picture is fluctuating and declining. It shows that after the beginning of the experiment, the length of 17 sideline turn back runs of athletes is

**Table 1.** Analysis of athletes' physical quality before and after endurance training.

Option	Group	Before	After	P
Five consecutive running run high (s)	Test group	24.85±0.8672	21.38±0.9069	0.0000
	Control group	23.85±0.7334	22.32±0.5308	0.0238
Half "Mi" mobile (s)	Test group	17.28±0.5344	14.68±0.9066	0.0000
	Control group	18.00±1.1053	16.72±1.0731	0.5582
30 seconds to sit up and sit on the slanting plate (times)	Test group	57.45±1.0923	63.22±1.4607	0.0118
	Control group	58.83±1.3441	61.49±1.3584	0.1721
30 seconds and 30kg hold (times)	Test group	48.94±2.0965	54.26±1.7381	0.0059
	Control group	47.46±3.8147	51.73±3.8048	0.2859



**Figure 1.** Duration change of 17 sideline turn back runs in the experimental group during six week training (s).

continuously shortened, which shows that in the actual sports process, athletes can complete movement and transformation in a shorter time, improve athletes' speed quality and sensitivity quality, and make sports mobilization obtain higher results in the arena.

As shown in Figure 2, the number of shots per minute in the experimental group during the six week training process is shown. It can be seen from Figure 2 that the change of the number of shots per minute of athletes fluctuates relatively large. Some athletes show an obvious downward trend after the beginning of the experiment, which may be due to the inadaptability of athletes to the adjustment of sports plan, and there is also a downward trend in the process of sports. Through the interview and analysis of athletes, it can be seen that some athletes have a certain tension during the test, which leads to the change of the number of shots, but on the whole, it is still a fluctuating state. The average value changes from 16.75 (PCS) → 17.77 (PCS) → 18.87 (PCS) → 18.29 (PCS) → 20.73 (PCS) → 21.44 (PCS) → 23.43 (PCS). It can be seen from the picture that the average number of shots taken by athletes shows an upward trend. Although there are fluctuations in the middle, it is still significantly higher than the number before the experiment.

As shown in Figure 3, the change of layup time of eight character dribble in the whole field in the six week training process of the experimental group is shown. It can be seen from Figure 3 that when the players lay up around the figure eight dribble in the whole court, the layup time of the players fluctuates and decreases, and there is a large range of change due to the influence of the players' personal play. But on the whole, the layup time of the eight athletes around the figure eight dribble has been shortened to a certain extent, which proves that their strength quality, speed quality and sensitivity quality have been improved. The average value changes from 53.02 (s) → 52.86 (s) → 50.93 (s) → 50.75 (s) → 47.49 (s) → 47.57 (s) → 47.08 (s), which is reflected in the picture, shows a downward trend of fluctuation, and is generally lower than the time before the experiment.

## DISCUSSION

### Training methods for improving aerobic endurance

Aerobic endurance training can effectively improve the oxygen delivery efficiency of athletes' body, and effectively delay the opportunity of muscle fatigue after high-intensity exercise, so as to improve athletes' physical strength. In daily teaching, athletes in different sports should choose different aerobic training methods. Endurance running is not only to lay a solid training foundation, but also an important training method to improve aerobic endurance training. In training, we should make a reasonable plan for the time and distance of endurance running. Generally, the exercise time is more than 45 minutes, while the exercise distance is more than 6 kilometers, and the athlete's heart rate should be maintained at about 150 times a minute, so as to achieve good exercise results. At the same time, rope skipping, swimming and cycling are good aerobic training methods. In aerobic training, athletes can effectively improve their cardiopulmonary function and the oxygen delivery capacity of various tissues of the body. At the same time, aerobic exercise can also effectively eliminate athletes' fatigue. In the process of aerobic exercise, due to the continuous contraction of muscles, it will cause certain pressure on human blood vessels, It speeds up the blood circulation and accelerates the metabolism of athletes. In aerobic training, we should also pay attention to the ways and methods of training. We should not simply pursue high-intensity and high-load training, but form a long-term training mechanism, so as to improve the effect of aerobic endurance training, protect athletes and avoid injuries and other factors affecting athletes' competition performance in the process of sports. As a coach, you should also be fully prepared for the improvement of aerobic endurance when planning aerobic exercises.

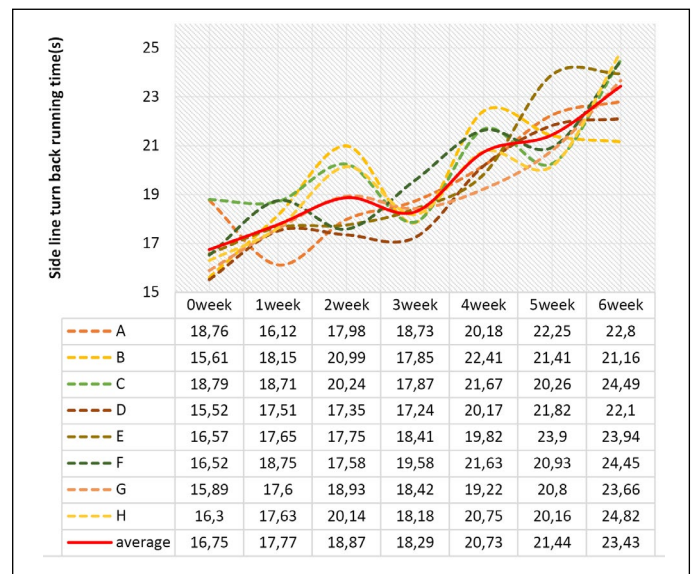


Figure 2. Changes in the number of shots per minute in the experimental group during six week training.

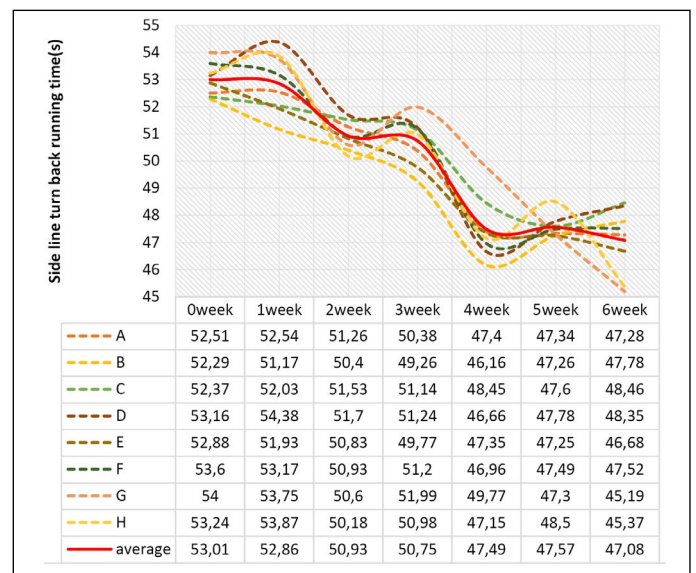


Figure 3. The change of layup time of eight character dribble in the whole field during six week training in the experimental group (s)

### Training methods for improving anaerobic endurance

Aerobic endurance training and anaerobic endurance training need to be carried out simultaneously, so as to effectively improve the physical quality of athletes. Anaerobic exercise is when athletes exercise. Because the movement frequency of each body is high and the instantaneous explosive force is large, the acquisition of oxygen is reduced, and the human body has to rely on the sugar in the body that has not been decomposed by oxygen for energy supply. Similarly, in anaerobic training, coaches should carry out targeted training according to different sports events of athletes, so as to improve the physical quality of athletes. Coaches can improve the strength of athletes' core muscles through flat support or barbells and other sports equipment, or improve the physical quality of athletes' lower limbs by climbing stairs or sprinting. The improvement of anaerobic endurance helps to improve the muscle quality of athletes. Targeted anaerobic training for different sports and different requirements for human muscle groups can effectively improve the muscle load of athletes, so as to improve the physical quality and competitive level of athletes. Because anaerobic endurance training puts forward higher requirements for human muscles and sports body, as coaches, we should also make reasonable planning

in training. Because in anaerobic endurance training, due to long-term anaerobic energy supply, the body excretes more lactic acid, which will accelerate muscle fatigue. Therefore, in the training arrangement, we should ensure the quality and quantity of anaerobic endurance training, rather than relying solely on long-term anaerobic training to improve anaerobic endurance. After the training, we should also make the muscles excrete lactic acid produced by exercise by means of massage and stretching. Avoid muscle strain and other injuries caused by muscle fatigue.

## CONCLUSION

Through the experiment of this paper, it can be seen that in basketball, purposefully increasing the proportion of endurance training can

effectively adjust the athletes' speed quality, strength quality, sensitivity quality and so on, so as to improve the athletes' basic skills and competitive ability, keep the sports mobilization in a better state and longer endurance time, and prevent the failure caused by lack of endurance. Therefore, coaches should design and improve the corresponding endurance training scheme for athletes according to the actual situation of athletes and the relevant methods of endurance training, so as to promote the improvement of athletes' physical quality and improve their competitive level.

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**AUTHORS' CONTRIBUTIONS:** The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Xiaofang Sun: writing and execution.

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