RESISTANCE TRAINING COMBINED WITH ATHLETIC TRAINING

TREINAMENTO DE RESISTÊNCIA ASSOCIADO AO TREINO DE ATLETISMO

ENTRENAMIENTO DE RESISTENCIA ASOCIADO AL ENTRENAMIENTO DE ATLETISMO

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ABSTRACT

Introduction: Athletics has high requirements for resistance and strength. Therefore, more and more researchers are focusing on improving these athletes' endurance and muscular strength, prioritizing their sports performance. Objective: Explore methods of adding resistance to conventional training to increase performance and muscle strength in track and field. Methods: Volunteers in the experiment and control groups were randomly assigned. Both groups received 10 weeks of physical training. The experimental group used a 10-meter lap run on the track, with squats, left and right-side squat jumps, fast bow squats, fast squats, fast trot runs, and lower limb lifting activities. The control group used only running in their conventional training. Results: Significant differences were found in the blood lactate test rates of the experimental groups. The maximum heart rate and heart rate at 3 minutes after the end of the test decreased, the recovery rate increased, the number of continuous squats and average squats in one minute increased significantly, the 8RM squat, 1RM squat, vertical jump. Long jump had very significant differences, including the vertical stiffness in the drop jump. Conclusion: The endurance and muscle strength of track and field athletes had positive impacts through the experimental training presented. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Track and Field; Physical Endurance; Physical Education and Training.

RESUMO

Introdução: O atletismo tem elevados requisitos para resistência e força. Portanto, cada vez mais pesquisadores direcionam o foco da pesquisa ao aprimoramento da resistência e da força muscular desses atletas, priorizando o seu desempenho esportivo. Objetivo: Explorar métodos com a adição de treinamento de resistência ao treino convencional visando aumentar o desempenho e a força muscular no esporte de atletismo. Métodos: Os voluntários dos grupos experiência e controle foram designados aleatoriamente. Ambos os grupos receberam 10 semanas de treinamento físico. O grupo experimental utilizou corrida de 10 metros de volta na pista, com agachamentos, salto de agachamento lateral à esquerda e à direita, agachamento rápido de proa, agachamento rápido, corrida rápida de trote e atividades de elevação de membros inferiores. O grupo de controle utilizou apenas a corrida em seu treino convencional. Resultados: Foram encontradas diferenças significativas nos índices de teste de lactato no sangue dos grupos experimentais. A frequência cardíaca máxima e a frequência cardíaca aos 3 minutos após o final do teste diminuíram, a taxa de recuperação aumentou, o número de agachamentos contínuos e média de agachamentos em um minuto aumentou significativamente, o agachamento de 8RM, agachamento de 1RM, salto vertical e salto em posição longa tiveram diferenças muito significativas, incluindo a rigidez vertical no salto de queda. Conclusão: A resistência e a força muscular dos praticantes de atletismo tiveram impactos positivos através do treinamento experimental apresentado. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Atletismo; Resistência Física; Educação Física e Treinamento.*

RESUMEN

Introducción: El atletismo tiene altas exigencias de resistencia y fuerza. Por ello, cada vez más investigadores dirigen el foco de la investigación a la mejora de la resistencia y la fuerza muscular de estos atletas, priorizando su rendimiento deportivo. Objetivo: Explorar métodos con la adición de entrenamiento de resistencia al entrenamiento convencional con el fin de aumentar el rendimiento y la fuerza muscular en el deporte del atletismo. Métodos: Se asignaron aleatoriamente voluntarios de los grupos experimental y de control. Ambos grupos recibieron 10 semanas de entrenamiento físico. El grupo experimental utilizó la carrera de 10 metros en la pista, con sentadillas, salto en cuclillas a la izquierda y a la derecha, sentadilla rápida, carrera de trote rápido y actividades de elevación de las extremidades inferiores. El grupo de control sólo utilizó la carrera en su entrenamiento convencional. Resultados: Se encontraron diferencias significativas en las tasas de prueba de lactato en sangre de los grupos experimentales. La frecuencia cardíaca máxima y la frecuencia cardíaca a los 3 minutos de terminar la prueba disminuyeron, la tasa de recuperación aumentó, el número de sentadillas continuas y el promedio de sentadillas en un minuto aumentaron significativamente, la sentadilla 8RM, la sentadilla 1RM, el salto vertical y el salto de longitud tuvieron diferencias muy significativas, incluyendo la rigidez vertical en el salto de caída. Conclusión:

La resistencia y la fuerza muscular de los practicantes de atletismo tuvieron impactos positivos a través del entrenamiento experimental presentado. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Atletismo; Resistencia Física; Educación y Entrenamiento Físico.*

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INTRODUCTION

Track and field sports is a kind of competitive sports with speed and endurance capacity as the basic indicators. Therefore, it requires high speed and endurance of athletes. In the track and field, athletes should do high-speed and variable-speed sports as much as possible within the specified time.[1] In addition, in order to have good explosive power and muscle endurance in the starting and accelerating stages of the competition, athletes also need to carry out high-intensity strength training during training. Reviewing the development history of track and field, we can find that the innovation of training methods is one of the main driving forces for the improvement and development of athletes' performance and training effect.[2] Compared with other types of athletes, track and field athletes have better long-time sprint ability, endurance and instantaneous speed performance, which is largely related to the training of muscle strength and endurance and the use of muscle strength on the sports field.[3] In the general daily training of athletes, whether through repeated training or group training, it is effective to maintain the overall level of athletes. However, if they are used to using a fixed training method, their body muscles will gradually adapt, which will greatly reduce the training effect and cause the rise of performance to encounter a bottleneck.[4] Therefore, for athletes, if they want to steadily improve their own performance, they cannot simply use a set of fixed training methods, but need more scientific and reasonable diversified training.

The optimization of training methods has always been one of the research contents in the field of sports. Some experiments have studied the relationship between the training methods of athletes and their performance. The experimental results show that if the athletes of jumping sports who are combined training through individual training methods are given special training of track and field strength, their performance and action standardization will be improved on the original basis.[5] Therefore, when the physical quality of an athlete is at a certain bottleneck, the original training mode can be changed, and more diversified training items can be used to organically combine with the original items, so that the performance can be continuously and effectively improved, and the standardization of action can be better performed. Muscle strength is the basis and premise of sports, and muscle endurance is the fundamental guarantee of physical fitness. It is found that with the increasing of age, the muscle mass, muscle endurance and strength of human body decrease year by year.[6] The decrease of body muscle content and strength endurance, the decrease of body flexibility and balance stability will increase the risk of injury during exercise, even reduce the quality of life and increase the probability of death.

This study proposes an innovative muscle training method for track and field events, and applies it to the daily training of athletes, trying to explore a special training program for improving the muscle endurance quality of track and field athletes.

METHOD

In this study, 50 track and field athletes from a school were selected as experimental subjects, and 50 subjects were randomly divided into the experimental group and the control group. The study and all the participants were reviewed and approved by Ethics Committee of Guangdong Ocean University (NO.2019GDOU23). Before the experiment, the basic statistics of each subject were as shown in Table 1, including age, height, weight, body mass index (BMI) and track and field training time. There were no significant differences in the above five indicators. All the subjects have no disease history, good physical condition, no serious injury in the past half year, no regular strength training, special skill training, etc., and no drugs.

According to the randomly assigned experimental group and control group, the endurance related indexes and muscle strength related indexes were tested before and after the experiment. The endurance indexes include blood lactate value, maximum heart rate, heart rate 3 minutes after the end of the test, and heart rate recovery rate. The muscle strength indexes include one-minute continuous squat, one minute seat experiment, eight maximum weight (RM) squats, one RM squat, vertical jump, and standing long jump.

RESULTS

Test results of endurance related indicators

After ten weeks of experimental training, the comparison of blood lactate index test results of the subjects is shown in Table 2. There were significant differences in the blood lactate test indexes of the experimental groups. The blood lactate value immediately after exercise before the experiment was 14.57 ± 1.919 (mmol / L), and the blood lactate value immediately after exercise after the experiment was 13.21 ± 1.879 (mmol / L), $P < 0.05$, with significant differences. The blood lactate value 15 min after exercise before the experiment was 12.94 ± 2.319 (mmol / L), and the blood lactate value 15 min after exercise after the experiment was 10.93 ± 3.129 (mmol / L), $P < 0.05$. There were also significant differences.

After the training proposed in this paper, the specific results are shown in Table 3. After the training, the maximum heart rate and the heart rate at 3 minutes after the end of the training in the experimental group and the control group decreased, and the recovery rate increased. However, the change in the experimental group was more obvious than that in the control group, with differences.

Table 1. Basic information of subjects.

Group	Age (years)	Height (m)	Body weight (kg)	BMI	Track and field training time (year)
Test group	18.72±2.859	1.73±0.11	66.48±10.116	22.67±1.609	4.97±3.049
Control group	18.77±3.439	1.73±0.08	65.01±7.397	22.24±2.139	6.39±4.638

Table 2. Blood lactate test results the experiment.

Group		Blood lactate value immediately after exercise (mmol / L)	Blood lactate value 15min after exercise (mmol / L)
Test group	Before experiment	14.57±1.919	12.94±2.319
	After the experiment	13.21±1.879*	10.93±3.129*
Control group	Before experiment	14.37±1.809	12.85±2.179
	After the experiment	13.92±1.549	12.25±2.749

*Represents $P < 0.05$, * * represents $P < 0.01$

Muscle strength index test results

After the experimental training designed in this paper, all subjects in the experimental group and the control group were tested for muscle endurance indexes, and the test data were compared and analyzed. The specific results are shown in Table 4.

By testing the lower limb muscle strength indexes of the two groups of subjects, the data comparison results are shown in Table 5. The four indexes of the experimental group were significantly improved, and the four indexes of the control group were not significantly different.

By testing the vertical stiffness (drop jump) of the subjects, the data comparison results are shown in Table 6. After the experiment, the vertical stiffness (drop jump) of the experimental group was 405.61 ± 90.819 (N / m / kg), $P < 0.01$, with significant difference. There was no significant difference in the data before and after the control group, but the value had a certain improvement.

DISCUSSION

Analysis on changes of endurance related indexes

Among the indexes of the experimental results, the biochemical principle of the difference between the blood lactate indexes before and after is analyzed. We can know that the intervention training method can effectively reduce the production of lactate in blood, inhibit the ability of lactate production in blood, and significantly improve the metabolic rate after the production of lactate. That is to say, the aerobic metabolic capacity of the athletes has been enhanced, so that the athletes can continue to exercise for a longer time under the same exercise state, and the ability to bear a stronger body load has been increased. Therefore, the intervention training method can improve the muscle endurance quality of athletes to a certain extent. The intervention training method organically combines behavior and methods, and its interval time is very flexible. It can also reduce other adverse factors affecting the improvement of speed endurance. The reason why the athletes' body will not be easily fatigued is that the intervention training method can not only reduce the production rate of lactic acid, but also achieve the purpose of improving the clearance rate of blood lactic acid, so that the muscle discomfort caused by the athletes' body can be delayed as much as possible. In the process of training with the intervention training method, the intermittent high-intensity training method that can improve the human lactic acid tolerance is integrated. This training method can make the body endure the continuous stimulation of the cumulative effect of lactic acid for a long time, so that the body muscle has an adaptive response to lactic acid, and improves the lactic acid tolerance of its muscle cells and related nerves. Through scientific and effective control of the proportion of exercise time and interval time, the content of lactic acid in the blood of athletes can be kept at a certain level, so that the amount of lactic acid in the body can be accumulated as much as possible, and the ability of lactic acid metabolism and glycolytic energy supply of the body can be improved, so as to enhance the comprehensive speed and muscle endurance quality of athletes.

Table 3. Heart rate test results.

Group		Maximum heart rate (B / min)	Heart rate 3 minutes after the end (B / min)	Recovery rate (%)
Test group	Before experiment	176±8	144±8	18.42±3.800
	After the experiment	170±5*	125±5**	27.12±2.850**
Control group	Before experiment	175±8	143±7	18.55±4.750
	After the experiment	172±7	131±8	24.36±3.800

*Represents $P < 0.05$, * * represents $P < 0.01$.

Table 4. Muscle endurance index test results.

Group		One minute continuous squat (Times)	One minute half squat (Times)	One minute seat test (Times)
Test group	Before experiment	37.15±1.721	48.28±1.816	34.62±1.530
	After the experiment	38.26±1.625**	49.09±1.721**	35.43±1.625
Control group	Before experiment	37.76±2.677	37.76±2.677	35.22±2.390
	After the experiment	37.65±2.581	37.85±2.501	34.92±2.677

*Represents $P < 0.05$, * * represents $P < 0.01$.

Table 5. Muscle strength index test results.

Group		8rm squat (kg)	1RM squat (kg)	Vertical jump (CM)	Standing long jump (CM)
Test group	Before experiment	53.51±5.692	66.78±7.190	44.08±2.197	226.70±10.585
	After the experiment	56.04±4.094**	70.03±5.193**	45.70±1.997**	231.46±19.672**
Control group	Before experiment	52.70±5.193	65.87±5.992	43.07±3.196	229.43±13.082
	After the experiment	54.22±4.594	67.80±5.792	43.17±2.097	230.65±12.782

*Represents $P < 0.05$, * * represents $P < 0.01$.

Table 6. Vertical stiffness (drop jump) index test results.

Group		Vertical stiffness (drop jump) (N/m/kg)
Test group	Before experiment	318.00±62.853
	After the experiment	405.61±90.819**
Control group	Before experiment	327.99±102.458
	After the experiment	354.08±114.832

*Represents $P < 0.05$, * * represents $P < 0.01$.

Analysis of changes of muscle strength related indexes

Muscle strength is also called the maximum muscle strength absolute muscle strength, which refers to the maximum contraction force produced by the muscle during contraction. According to the specific types of muscle contraction, muscle contraction can be further divided into static contraction and dynamic contraction. When the muscle is contracted at super equal length, the rapid contraction capacity generated is also called muscle power, which is also one of the manifestations of muscle explosive force. On the premise and basis of previous studies, this study explored the comprehensive impact of intervention training on muscle endurance and muscle exercise. After 10 weeks of intervention exercise training, the subjects' 8rm and 1RM squat test strength, vertical jump and standing long jump performance were significantly improved. We found that after 10 weeks of intervention training, the improvement of the vertical jump performance of the experimental group was more obvious than that of the general training. The improvement of the vertical jump performance means the improvement of the explosive power of the lower limb muscles. This is the same as the previous research conclusion. Therefore, the intervention training and other training methods are organically integrated, and targeted training can comprehensively improve the physical quality of athletes. Muscle endurance is one of the important components of the exercise ability of healthy body, which refers to the acid resistance ability of skeletal muscle to keep the exercise state unchanged and fight muscle fatigue during the continuous contraction and relaxation process. According to the experimental data of this study, there was no significant change in the subjects' scores of one minute continuous squat, one minute half squat and one minute seat experiment before and after the intervention. After analyzing the experimental data before and after the exercise, it was found that the results of one minute continuous squat and one minute half squat in the control group and the experimental group were significantly improved, but the results of one minute continuous squat and one minute half squat in the experimental group were significantly improved.

CONCLUSION

In order to enhance the muscle endurance and muscle strength of athletes and ensure the healthy development of athletes, we can improve the muscle endurance and muscle strength of track and field athletes through special training intervention, which not only helps to reduce the sports risk and reduce the sports injury, but also can improve the competition performance of athletes to a certain extent. The sports track and field training method proposed in this paper can effectively improve the average clearance rate of blood lactic acid of athletes and accelerate the recovery of heart rate. With the continuous progress of contemporary training theory and technology, the workers engaged in physical education have realized that the endurance performance of muscles is the basic condition and important factor affecting track and field performance. For most athletes, they not only need to have good muscle strength and sports skills, but also need to have excellent muscle endurance. The comprehensive and stable play of multiple factors is the fundamental guarantee to maintain excellent performance.

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