EFFECTS OF ATHLETIC WALKING ON THE PHYSICAL ENDURANCE OF ATHLETES

EFEITOS DA MARCHA ATLÉTICA SOBRE A RESISTÊNCIA FÍSICA DOS ATLETAS

EFECTOS DE LA MARCHA DEPORTIVA EN LA RESISTENCIA FÍSICA DE LOS ATLETAS

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ABSTRACT

Introduction: Athletic walking is a physical endurance test. This sport has a long competition time and a high load intensity. The long-term continuous movement of muscles is the most prominent characteristic of this sport. Strength and endurance are essential physical factors that determine the performance of the runners who do it. Physical endurance is an essential indicator to evaluate the level of physical training in athletic walking. Objective: This study aims to analyze the effect of endurance training on the physical fitness and competition performance of athletic walkers. Methods: This work selects four athletes as the research object. The athletes undergo one month of resistance training. The athletes recorded their physiological and biochemical indicators before and after resistance training. Then, the mathematical statistics method was used to analyze their physiological and biochemical indicators. Results: Hemoglobin levels in the last three weeks of resistance training were significantly higher than in the first week (P<0.01). During endurance training, the athletes' morning blood urea peak appeared in the first test after going to high altitude (P<0.05). Conclusion: Endurance training can improve the fitness of athletic walkers. Resistance training effectively stimulates the blood system of athletes for at least two weeks. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Gait; Athletes; Endurance Training; Biological Monitoring.

RESUMO

Introdução: A marcha atlética é uma prova de resistência física. Este esporte tem um longo tempo de competição e uma alta intensidade de carga. O movimento contínuo dos músculos a longo prazo é a característica mais proeminente deste esporte. Força e resistência são fatores físicos essenciais que determinam o desempenho dos corredores que a praticam. A resistência física é um indicador essencial para avaliar o nível de treinamento físico na marcha atlética. Objetivo: Este estudo tem como objetivo analisar o efeito do treinamento de resistência sobre a aptidão física e o desempenho em competição dos praticantes de marcha atlética. Métodos: Este trabalho seleciona quatro atletas como o objeto de pesquisa. Os esportistas passam por um mês de treinamento de resistência. Os atletas registraram seus indicadores fisiológicos e bioquímicos antes e depois do treinamento de resistência. Em seguida, foi utilizado o método de estatística matemática para analisar seus indicadores fisiológicos e bioquímicos. Resultados: Os níveis de hemoglobina nas últimas três semanas de treinamento de resistência foram significativamente maiores do que os da primeira semana (P<0,01). Durante o treinamento de resistência, o pico da ureia sanguínea matinal dos atletas apareceu no primeiro teste depois de ter ido para altitude alta (P<0,05). Conclusão: O treinamento de resistência pode melhorar a aptidão física dos praticantes de marcha atlética. O treinamento de resistência estimula efetivamente o sistema sanguíneo dos esportistas por pelo menos duas semanas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Marcha; Atletas; Treino Aeróbico; Monitoramento Biológico.*

RESUMEN

Introducción: La marcha atlética es una prueba de resistencia física. Este deporte tiene un largo tiempo de competición y una alta intensidad de carga. El movimiento continuo y prolongado de los músculos es la característica más destacada de este deporte. La fuerza y la resistencia son factores físicos esenciales que determinan el rendimiento de los corredores que la practican. La resistencia física es un indicador esencial para evaluar el nivel de entrenamiento físico en la marcha atlética. Objetivo: Este estudio pretende analizar el efecto del entrenamiento de resistencia sobre la aptitud física y el rendimiento en competición de los practicantes de marcha atlética. Métodos: Este trabajo selecciona a cuatro atletas como objeto de investigación. Los atletas realizaron un mes de entrenamiento de resistencia. Los atletas registraron sus indicadores fisiológicos y bioquímicos antes y después del entrenamiento de resistencia. A continuación, se utilizó el método de estadística matemática para analizar sus indicadores fisiológicos y bioquímicos. Resultados: Los niveles de hemoglobina en las últimas tres semanas de entrenamiento de resistencia fueron significativamente más altos que los de la primera semana (P<0,01). Durante el entrenamiento de resistencia, el pico de urea en sangre matinal de los atletas apareció en *la primera prueba después de ir a la altitud (P<0,05). Conclusión: El entrenamiento de resistencia puede mejorar la condición física de los caminantes atléticos. El entrenamiento de resistencia estimula eficazmente el sistema sanguíneo de los deportistas durante al menos dos semanas.* ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores**:** *Marcha; Atletas; Entrenamiento Aeróbico; Monitoreo Biológico.*

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INTRODUCTION

At present, the research on race walking events at home and abroad mainly focuses on athletes' biomechanical characteristics and technical characteristics. There are few academic studies on physical function monitoring of endurance training in race walkers.[1] Therefore, this paper conducts physiological and biochemical monitoring of endurance training of female race walkers. This paper analyzes its training characteristics and the changing laws of related physiological and biochemical indicators. The conclusions of this paper can provide a theoretical basis for the monitoring of endurance training in race walking events in the future.

METHOD

Research objects

We selected four elite female race walkers as research subjects.[2] The mean age was 18.6±2.10 years. The height was 164.4±0.33cm, and the weight was 51.7±0.42kg.

Research methods

Monitoring indicators and test methods

Monitoring indicators include morning pulse, hemoglobin (Hb), blood urea (BU), and creatine kinase (CK). The hemoglobin test method is the ferric cyanide method.[3] The test method of blood urea and creatine kinase is based on a dry chemical test principle.

Blood sample collection

Each person took 0.5ml of antecubital venous blood on the morning of the test day. In this experiment, 20 μL of blood was firstly separated with a capillary pipette for hemoglobin determination.[4] Blood urea and creatine kinase were determined after centrifugation of the remaining blood and serum separation.

Simulation model of body state of race walking

μ represents the performance state of the athlete's physical state. χ represents pre-competition athlete pressure. ϑ represents the main factor that triggers the athlete's training. We use Equation (1) to give the main effects of the various dimensions of the physical state under the athlete training

$$\beta(\sigma)=\frac{\mu*\chi}{\Phi(\wp)}*\vartheta\cdot\partial(d) \tag{1}$$

Φ stands for the body exhaustion factor. $\wp$ stands for Calculus Tool. $\partial(d)$ represents the factor category for the different training of the athlete. Ψ represents the independent training variable for track and field athletes. ζ represents the athlete training dependent variable. $\aleph(p)$ represents the average score of the athlete's training factor.[5] We use two types of indicators, physiological and biochemical, to classify the physical state of exercise into different stages.

$$\Re^*(\varpi)=\frac{\aleph(p)\times\varsigma}{\Psi(\eta\cdot\gamma)}\times\frac{\partial(\delta*\gamma)}{\vartheta(\omega)}\times\kappa(\lambda) \tag{2}$$

η represents the function of the athlete training factor. γ represents the degree of emotional and physical exhaustion of the athlete. $\kappa(\lambda)$ represents the athlete's negative evaluation of the sport. ∂ represents the physical and biochemical performance characteristics of the athlete's physical state. δ represents the measurement range of the athlete's physical state. γ represents the athlete's physical state evaluation dimension. $\vartheta(\omega)$ represents the independent variable and dependent variable weight coefficient of the relationship between athlete training and physical state. ν represents the moderator variable between athlete training and physical state. $O(\varepsilon)$ represents the internal consistency coefficient of the negative rating dimension.[6] We use equation (3) to calculate the mediating variable of the physical state relationship of track and field athletes

$$H(\Phi)=\frac{O(\varepsilon)\times\nu}{K\times(\chi)^*}\times O(\varpi) \tag{3}$$

K represents the third variable between the two physical states of the athlete. $O(\varpi)$ represents the source of control of the athlete's physical state. M'' stands for the overall performance factor of the athlete training. $\mu(\tau)$ represents the consistency coefficient for the evaluation dimension of the athlete's physical state. $\mu(j)$ represents the measurement threshold of the athlete's physical state.[7] We use formula (4) to give the main trend characteristics of athletes' training and physical state before the competition

$$\iota(E)=\frac{\mu(j)\times\mu(\tau)}{M''}\times\varpi(\wp)\times\theta(\kappa)+\ell(l,p) \tag{4}$$

$\varpi(\wp)$ represents the variation pattern of athlete training. $\theta(\kappa)$ represents the correlation coefficient between the athlete's training and physical condition. $\ell(l,p)$ represents the main factors influencing each other's training and physical state at different stages. $\iota(E)$ represents the primary trend feature set of athletes' training and physical state at different stages before the competition.[8] Based on the results to establish the principle model of the training technology and physical state of the race walkers

$$\varphi(\varpi)=\frac{\iota(E)\times\varpi(\Sigma)\times\sigma_k}{B(I)}\times X(\Upsilon) \tag{5}$$

$\varpi(\Sigma)$ represents the leading cause of the physical state. σ_k represents the primary production mechanism of the athlete's pre-competition training and physical state.[9] $B(I)$ represents the central causal relationship between the athlete's pre-competition training and physical state. $X(\Upsilon)$ represents the physiological response characteristics of athletes in different stages of training and physical state before the competition.

Data processing and statistics

We used Excel 2013 for data processing. This paper uses SPSS11.5 statistical software to analyze data.[10] All data are expressed as mean ± standard deviation. In this paper, the Kolmogorov-Smirnov test was used to analyze the data distribution. P<0.05 is the significant level. P<0.01 is a very significant level.

There is no need for a code of ethics for this type of study.

RESULTS

Morning pulse changes

Table 1 shows that the average morning pulse of athletes in the second, third, and fourth weeks of endurance training was significantly lower than that in the first week (P<0.01).

Changes in hemoglobin (Hb)

Hemoglobin levels were significantly higher in the last three weeks of the endurance training process than in the first week. (Table 2) The Hb level increased significantly in the second week and then decreased slightly in the third and fourth weeks.

Changes in blood urea (BU)

The peak of morning BU in athletes during endurance training occurred on test 1. It was significantly higher than the BU level on test days in subsequent weeks (P<0.01). (Table 3) After exercise, the peak of BU of athletes appeared after a particular intensity class in the second week, slightly higher than the first test value after going to the plateau.[11] But it is not statistically significant.

Changes in Creatine Kinase (CK)

Peak morning CK in athletes during endurance training occurred in week 3. Although it was higher than the 1st test value, it was not statistically significant.[12] The peak of post-exercise CK in athletes appeared after a specific intensity class in the third week. It was significantly higher than the first test value after going to the plateau (P<0.01). (Table 3)

Table 1. Changes in the morning pulse of athletes during endurance training.

	The first week	The second week	The third week	The fourth week
Morning pulse (bpm)	70.6±8.55	65.7±5.23	63.8±5.03	62.3±5.36

Table 2. Changes in Hb of athletes during endurance training.

	Hb(g/dL)
July 24	12.88±0.43
July 28	12.78±1.20
July 29	13.78±0.40
August 4	14.88±0.88
August 10	14.84±0.84
August 11	14.44±0.70
August 15	13.72±0.52

Table 3. Morning BU and CK changes in athletes during endurance training.

	BU(mmol/L)	CK(U/L)
July 24	6.5±0.40	434.4±171.32
July 25	5.6±0.56	341.7±151.44
July 29	5.2±0.70	247.4±60.31
August 4	5.1±0.27	221.0±57.76
August 10	5.5±0.26	261.0±73.68
August 11	5.4±0.54	502.7±54.57
August 15	4.6±0.33	178.7±70.28

DISCUSSION

During endurance training, the general trend of the morning pulse of athletes showed a trend from high to low and then stabilized.[13] The mean value of the morning pulse of athletes in the 2nd, 3rd, and 4th weeks was significantly lower than that in the first week. It was observed that the subjective fatigue of the athletes after 3 weeks was significantly weaker than that in the first week. This reflects the process of the body from adaptation to gradual adaptation. Although the morning pulse is a simple indicator, its significant changes can be directly used to reflect the body's adaptation process to endurance training. It can be used as an objective indicator to monitor the subjective fatigue of athletes during endurance training.

The hemoglobin concentration does not increase continuously at the plateau. During endurance training, the hemoglobin level of athletes first increased and then stabilized. The hemoglobin levels in the last three weeks were significantly higher than those in the first week.[14] The minimum duration of endurance training should be 21 to 28 days. If you continue to stay for more than 28 days, the red blood cell count will not continue to grow. The duration of endurance training should be 21 to 28 days. Therefore, the endurance training cycle is 24 days. Hemoglobin showed a trend of rising first and then leveling off. This shows that the implementation of this endurance training is effective in stimulating the blood system.

Urea is a metabolite of protein. We can reflect the size of the training load by measuring the blood urea level. During this endurance training process, although the average weekly training amount of the athletes reached 120.3km, no one case of blood urea exceeded 7mmol/ in the whole monitoring process. In addition, we found that the blood urea level on the test days of each week was significantly lower than the first test level after going to the plateau (P<0.01). This indicates that the blood urea level will decrease significantly after the athletes "acclimate" to the hypoxic plateau environment during endurance training.

The CK mainly produces serum CK in the muscle entering the blood through the muscle cell membrane. Hypoxia, insufficient relative energy supply, and acidic products caused by an accumulation of blood lactic acid during exercise are the leading causes of muscle cell membrane damage. CK leaks into the blood through broken cell membranes. It can be seen that the greater the exercise intensity and the more severe the physical damage during exercise, the more significant the increase in the level of CK in the blood. Athlete CK peaks occurred at week three throughout the monitoring of endurance training. It was 1.6 times higher than the CK value in the morning of the day and significantly higher than the first test value after going to the plateau, and the CK recovery value on the following day was as high as 500U/L.

CONCLUSION

The changes in morning pulse can be directly used to reflect the adaptation process of race walkers to endurance training. It can be used as an objective indicator to monitor the subjective fatigue of athletes during endurance training. Therefore, we believe that every athlete should record their daily morning pulse during endurance training. This provides an intuitive basis for trainers to schedule or adjust training loads. Hb of race walkers increased significantly in the second week of endurance training and decreased slightly in the third and fourth weeks. This indicates that the effective stimulation of the blood system of the race walkers in the endurance training environment can be maintained for at least two weeks. The blood urea level of female race walkers during high-intensity training at high altitudes decreased significantly after the athletes "acclimated" to the endurance training environment. Therefore, when using this indicator to evaluate the endurance training load, the variation of this indicator should be considered. During the monitoring of endurance training, we used serum CK levels to evaluate the training intensity of race walkers with high sensitivity.

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