PHYSIOLOGICAL CHANGES IN MARTIAL ARTS ATHLETES IN ALTITUDE TRAINING

ALTERAÇÕES FISIOLÓGICAS DOS ATLETAS DE ARTES MARCIAIS EM TREINOS DE ALTITUDE

CAMBIOS FISIOLÓGICOS DE LOS ATLETAS DE ARTES MARCIALES EN EL ENTRENAMIENTO EN ALTITUD

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ABSTRACT

Introduction: Recent studies have shown that altitude training can significantly improve hemoglobin content in athletes. This allows for greater oxygen transport to the muscles and, consequently, greater load capacity during training. However, there is no confirmed evidence of athlete-specific training in martial arts. Objective: Explore the load capacity and ability changes caused by high altitude training in athletes. Methods: The research selected ten high-level martial arts athletes as volunteers to compare the functional changes caused by high-altitude training. Physical and functional data were collected before the beginning of the experiment and at its conclusion after three weeks. Results: Measured abilities were significantly improved after 11 days of altitude physical training. After 21 days of altitude training, these abilities improved significantly. The urea nitrogen and creatine kinase values increased rapidly with increasing load intensity in the first stage, peaked in the second stage, and decreased in the third stage. Conclusion: Training in the low-pressure hypoxic environment at high altitude, using dual stimulation of hypoxia and exercise to make the athletes stress response, can stimulate the physical potential to achieve a range of physiological abilities to improve the body's resistance to hypoxia. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Physical Conditioning, Human; Exercise; Athletes.

RESUMO

Introdução: Estudos recentes mostraram que o treinamento de altitude pode melhorar significativamente o conteúdo da hemoglobina em atletas. Isso permite um maior transporte de oxigênio para a musculatura e, consequentemente, maior capacidade de carga durante os treinos. Porém, não há evidências confirmadas nos treinos específicos de atletas em artes marciais. Objetivo: Explorar as alterações na capacidade de carga e as mudanças de habilidade provocada nos atletas pelo treinamento físico em alta altitude. Métodos: 10 atletas de artes marciais de alto nível foram selecionados como voluntários para pesquisa no intuito de comparar as alterações funcionais ocasionadas pelo treino de altitude. Os dados físicos e funcionais foram coletados antes do início do experimento e, ao seu término, após três semanas. Resultados: As habilidades mensuradas foram significativamente aprimoradas após 11 dias de treinamento físico de altitude. Após 21 dias de treinamento físico de altitude, essas habilidades melhoraram significativamente. Os valores de nitrogênio uréico e creatinoquinase aumentaram rapidamente com o aumento da intensidade de carga no primeiro estágio, atingiram o pico na segunda etapa e diminuíram no terceiro estágio. Conclusões: O treinamento no ambiente de hipóxia de baixa pressão em altitude elevada, utilizando a estimulação dupla de hipóxia e exercício para fazer os atletas terem resposta ao estresse, pode estimular o potencial físico, de modo a alcançar uma série de habilidades fisiológicas para melhorar a resistência do corpo à hipóxia. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: Condicionamento Físico Humano; Exercício Físico; Atletas.

RESUMEN

Introducción: Estudios recientes han demostrado que el entrenamiento en altitud puede mejorar significativamente el contenido de hemoglobina en los atletas. Esto permite un mayor transporte de oxígeno a los músculos y, en consecuencia, una mayor capacidad de carga durante el entrenamiento. Sin embargo, no hay pruebas confirmadas en el entrenamiento específico de los atletas en las artes marciales. Objetivo: Explorar las alteraciones en la capacidad de carga y los cambios de habilidad provocados en los atletas por el entrenamiento físico en altura. Métodos: Se seleccionaron 10 atletas de artes marciales de alto nivel como voluntarios para la investigación con el fin de comparar los cambios funcionales causados por el entrenamiento en altura. Se recogieron datos físicos y funcionales antes del inicio del experimento y, al final del mismo, después de tres semanas. Resultados: Las habilidades medidas mejoraron significativamente tras 11 días de entrenamiento físico en altitud. Tras 21 días de entrenamiento en altitud, estas capacidades mejoraron significativamente. Los valores de nitrógeno ureico y creatina quinasa aumentaron rápidamente con el incremento de la intensidad de la carga en la primera etapa, alcanzaron un máximo en la segunda etapa y disminuyeron en la tercera. Conclusión: El entrenamiento en el entorno hipóxico de baja presión a gran altura, utilizando la estimulación dual de la hipoxia y el ejercicio para

hacer que los atletas respondan al estrés, puede estimular el potencial físico para lograr una serie de habilidades fisiológicas para mejorar la resistencia del cuerpo a la hipoxia. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Acondicionamiento Físico Humano; Ejercicio Físico; Atletas.*

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INTRODUCTION

Altitude training refers to a special training method that uses the dual stimulation of altitude hypoxia and exercise hypoxia to deepen the stress response of human body, so as to improve various functions and exercise ability of the body. Since the 1968 Olympic Games was held in Mexico (2200 m), altitude training method has been valued by researchers, coaches and athletes.[1] Recent studies have shown that altitude training can significantly improve the hemoglobin content of athletes, and then improve the ability of blood to transport oxygen and muscle to use oxygen. Therefore, altitude training has always been welcomed by endurance events dominated by physical fitness such as long-distance running, cycling, swimming and rowing.[2]

This study will cooperate with 10 high-level Wushu athletes to carry out phenotypic research and biological research, make mathematical statistics on their body monitoring data, analyze the plateau physical fitness training, formulate a reasonable and effective plateau physical fitness training scheme according to various physical indicators of Wushu routine, and provide a new and effective scheme for the special plateau physical fitness training of Wushu routine on the premise of maintaining physical health and aiming at improving sports performance.

Subjects and methods

Experimental subject

Ten male Wushu Athletes of a provincial wushu team were recruited as the research object. All the experimenters confirmed that they had not performed strenuous exercise 24 hours before the experiment, and all the experimental subjects had a physical examination to confirm that there were no injuries in key positions such as lower limbs, knees and feet. Each experimenter had good physical function and rich competition experience.[3] Before the experiment, the experimenter explained the experiment intention and process clearly to each experimental object, and signed an informed consent with each experimental object. The average age of the 10 male Wushu athletes recruited is 20 years old, the average height is 175cm, the average weight is 65.12kg, and they have rich experience in Wushu competition.

Literature method

Through the library of Internet and other channels, search with the keywords of "altitude training", "physical fitness", "altitude training", "hormone", "body composition" and so on. Query relevant literature and obtain valuable references for this research, which provides a solid theoretical basis for the research of this paper. And consulted the works and related papers on altitude training and physical training, and obtained the literature review.

Mathematical statistics

The computer is used to calculate, compare and analyze the physiological and physical fitness test results of athletes under the original training conditions and the physiological and physical fitness test results of athletes under the new training conditions. Verify the reliability and accuracy of the results, provide accurate data and indicators for quantitative analysis, and draw corresponding conclusions.[4]

Measurement method

The average age of 10 male Wushu Athletes in a province is 20 years old, the average height is 175cm and the average weight is 65.12 kg. The relevant instruments were used to track and test the 10 Wushu athletes.

RESULTS

The plateau physical fitness training is divided into three stages. The first stage is the adaptation stage. The main purpose is to make 10 high-level Wushu athletes adapt to the plateau environment as soon as possible and prepare for the later high-intensity training. If the high-intensity training is carried out directly at this stage, it may cause irreversible damage to the athletes' physical function.[5] The second stage is the improvement stage. Various items of plateau physical fitness training are carried out gradually, and the training intensity can reach 80% ~ 90% of the maximum intensity. The third stage is the breakthrough stage. The physical function indexes of 10 high-level Wushu athletes have been significantly improved, and the actual combat performance is significantly better than the training plans and arrangements of previous stages.

Impact on oxygen transport index

RBC, HB and HCT are the core indicators reflecting the oxygen transport capacity of human body and the effectiveness of plateau physical training. For high-level Wushu athletes, the fast oxygen transport ability can prolong their body's high-intensity exercise time, withstand higher-intensity exercise, and have stronger endurance and explosive power than their opponents in the competition, so as to help Wushu athletes win the competition under the condition of equal technical level.[6] Altitude physical training has the characteristics of low oxygen, low pressure and large temperature difference between day and night. The hypoxic environment promotes the changes of oxygen transport indexes of athletes. The specific results are shown in Figure 1, 2 and 3.

Impact on Bun

Bun, also known as blood urea, is the nitrogen separated from the catabolism of nitrogen containing substances such as protein in human function, which is transformed into urea through the liver and discharged from the body through the kidney. It is a sensitive index of athletes' fatigue state and the reflection of exercise load, especially the amount of exercise. Bun will increase significantly during intense sports, but will gradually decrease after sports. The index value and change status. High level Wushu athletes are faced with concentrated and high-level

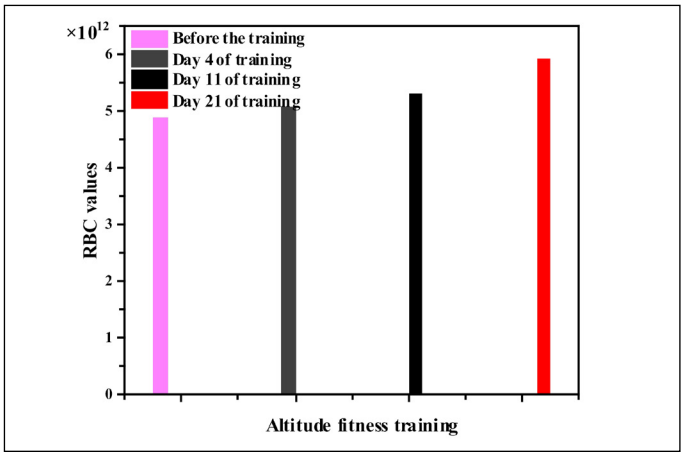

Figure 1. Effect of altitude physical training on RBC value of athletes.

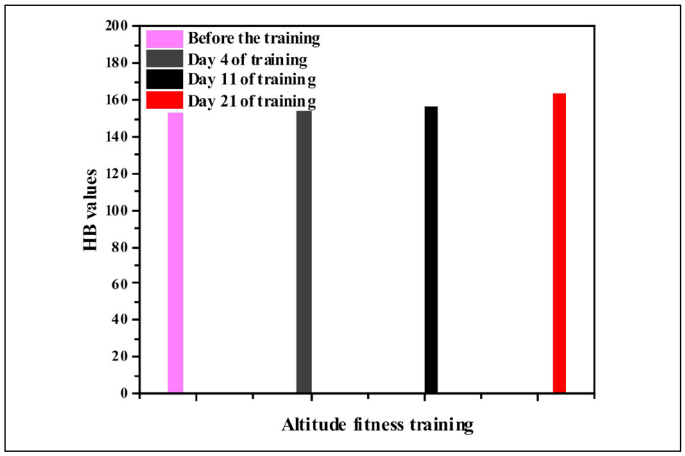

Figure 2. Effect of altitude physical training on Athletes' HB value.

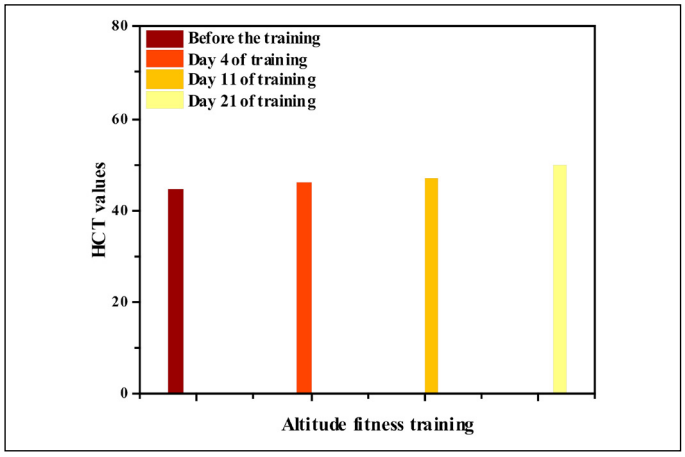

Figure 3. Effect of altitude physical training on HCT value of athletes.

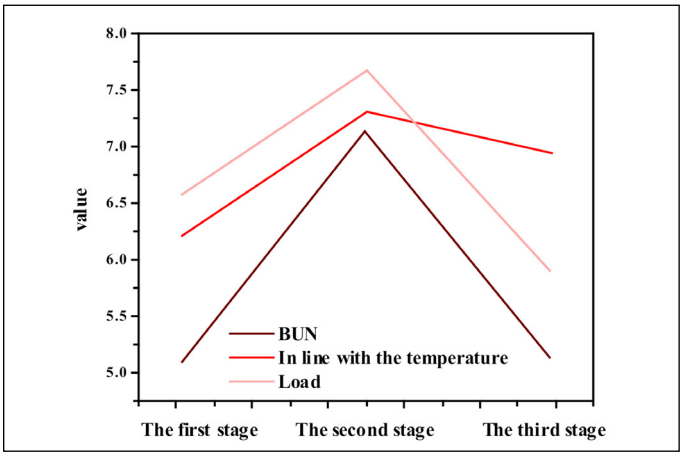

Figure 4. Relationship between exercise load and bum.

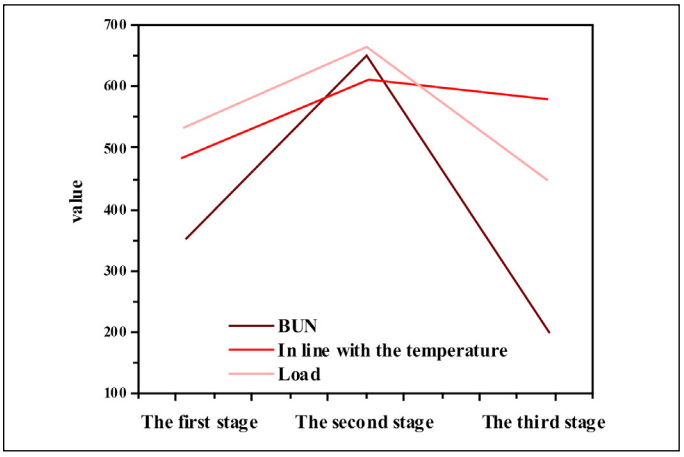

Figure 5. Relationship between exercise load and CK.

competitions. The rapid recovery ability of their bun index is particularly critical for them to win the competition.[7] Through plateau physical training, the relationship between bun index, load intensity and load of 10 high-level Wushu athletes is shown in Figure 4.

In the first stage, the exercise load intensity of 10 high-level Wushu athletes gradually increased, and their body load also gradually increased. With the increase of load intensity and load, the bun of Wushu athletes also increased rapidly, especially reaching the maximum value of 7.35mmol/L in the second stage, which shows that plateau physical training has a great stimulation on the body and achieved the purpose of plateau physical training.[8] In the third stage, the load intensity of athletes decreased only slightly, but their load decreased significantly, bun decreased significantly, and even reached the level before the first stage of training on the plateau. It shows that the training load arrangement is very reasonable, and the physical function level of 10 Wushu athletes has been significantly improved. After high-intensity sports, their physical function can quickly return to the normal level, and there will be no high state.[9]

Impact on CK

CK indirectly reflects the degree of muscle loss after strength training. It is mainly used to measure the wear of muscle fibers. It is closely related to load intensity and load. After high-intensity exercise, the ultrastructure of skeletal muscle will change and muscle fibers will be lost. Low CK value means that the loss of athletes is low after high-intensity training, which is conducive to athletes to maintain high-intensity exercise for a long time.[10] The value and variation of CK in plateau physical training and its relationship with load intensity and load are shown in Figure 5.

Similar to Bun index, CK index rose rapidly after officially Entering Plateau physical training, and reached the peak in the second stage. In the third stage of training, the load intensity decreased slightly, the body load decreased, and the CK value decreased rapidly, even lower than the level before plateau physical training, indicating that the intensity and load of this plateau physical training were normal, and the high-intensity exercise loss of 10 high-level Wushu athletes was significantly reduced.[11]

DISCUSSION

There were significant changes in the data of lung function and heart function before, during and after altitude physical fitness training; The expression of hemoglobin related factors (BP) in RBC signaling pathway was significantly higher, and the protein synthesis rate was accelerated. Therefore, training in the environment of low-pressure hypoxia at high altitude, using the dual stimulation of hypoxia and sports to make athletes have stress response, can stimulate the potential of the body, so as to achieve a series of physiological abilities to improve the body's resistance to hypoxia, and help endurance athletes break through the physical limit. In fact, the plateau physical training under the condition of hypoxia has a special honing effect on the physical strength and will of the human body. Compared with plain training, plateau physical training can better develop the potential of the body and improve the level of training.

CONCLUSION

High altitude physical training can significantly improve the RBC, HB and HCT values, and can significantly improve the blood oxygen carrying and oxygen carrying capacity of high-level Wushu athletes. This ability improved significantly after 11 days of altitude physical training. After 21 days of altitude physical training, this ability can significantly

improve bun and CK values. In the first stage, it increased rapidly with the increase of load intensity and load, and reached the peak in the second stage, but decreased in the third stage, It shows that plateau physical fitness training enhances the body recovery ability and muscle anti injury ability of high-level Wushu athletes after high-intensity exercise. However, altitude training also has high risks. It is not easy to control it well. We should constantly explore the law of plateau physical fitness training, improve the scientific level of training and promote the healthy training of athletes, which is one of the fields that our sports researchers have worked hard for a long time. At present, Wushu routine athletes are recognized as highly difficult sports in the sports industry, which need long-term training, and have extremely high requirements for athletes' willpower. However, training in plateau areas can have a fairly objective and positive impact on the physical function and will of Wushu routine athletes.

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

AUTHORS' CONTRIBUTIONS: The author made significant contributions to this manuscript. YY: writing; data analysis; article review and intellectual concept of the article.

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