

NUTRITIONAL INTERVENTION ON POST-TRAINING FATIGUE IN COLLEGE ATHLETES



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INTERVENÇÃO NUTRICIONAL NA FADIGA PÓS-TREINO EM ATLETAS UNIVERSITÁRIOS

INTERVENCIÓN NUTRICIONAL EN LA FATIGA POST-ENTRENAMIENTO EN DEPORTISTAS UNIVERSITARIOS

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ABSTRACT

Introduction: The modulation of post-training fatigue in colleges and universities is an important part of today's physical education. The adjustment of sports fatigue is a fundamental aspect of modern college physical education, and its control is of great importance for the elevation in the sport level of athletes. **Objective:** Explore the effects of nutritional intervention on post-training fatigue in college athletes. **Methods:** 40 athletes were randomly selected as volunteers for the research, divided into control and experimental group, and practiced the same type of exercise and same intensity. The athletes in the experimental group took food in strict accordance with the food mixture described in the article, while the control group kept their regular diet unchanged. After the experiment, sports training was performed, followed by muscle creatine enzyme measurement and laboratory analysis of blood urea. These data were compared and analyzed with those before the experiment. **Results:** After adjusting the dietary structure, the CK and Bu indices of the athletes in the experimental group showed a downward trend, indicating that adjusting the nutritional structure can effectively improve the post-training fatigue of college athletes. **Conclusion:** It is recommended that physical education teachers and college coaches adjust the lifestyle and dietary structure according to the actual situation of the students, aiming to promote integral development and improved sports performance. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Nutrition in Sport; Physical Education and Training; Muscle Fatigue.

RESUMO

Introdução: A modulação da fadiga pós-treino nas faculdades e universidades é uma parte importante da atual educação física universitária. O ajuste da fadiga esportiva é um aspecto fundamental da educação física universitária moderna e seu controle é de grande importância para a elevação no nível esportivo dos atletas. **Objetivo:** Explorar os efeitos da intervenção nutricional sobre a fadiga pós-treino dos atletas universitários. **Métodos:** Foram selecionados 40 atletas aleatoriamente como voluntários para a pesquisa, divididos em grupo controle e experimental, praticaram o mesmo tipo de exercício físico e com a mesma intensidade. Os atletas do grupo experimental tomaram alimentos em estrita conformidade com a mistura alimentar descrita no artigo, enquanto o grupo de controle manteve sua alimentação regular inalterada. Após o experimento, foi realizado um treinamento esportivo, seguido de aferição da enzima creatina muscular e análise laboratorial de ureia no sangue. Esses dados foram comparados e analisados com os anteriores ao experimento. **Resultados:** Após o ajuste da estrutura dietética, os índices de CK e Bu dos atletas do grupo experimental mostraram uma tendência descendente, indicando que o ajuste da estrutura nutricional pode efetivamente melhorar a fadiga pós-treino dos atletas universitários. **Conclusão:** Recomenda-se aos professores de educação física e treinadores universitários ajustarem os hábitos de vida e estrutura alimentar de acordo com a situação real dos alunos, visando a promoção do desenvolvimento integral e melhora no desempenho esportivo. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Nutrição no Esporte; Educação Física e Treinamento; Fadiga Muscular.

RESUMEN

Introducción: La modulación de la fatiga post-entrenamiento en colegios y universidades es una parte importante de la educación física universitaria actual. El ajuste de la fatiga deportiva es un aspecto fundamental de la educación física universitaria moderna y su control es de gran importancia para la elevación del nivel deportivo de los atletas. **Objetivo:** Explorar los efectos de la intervención nutricional sobre la fatiga post-entrenamiento en atletas universitarios. **Métodos:** 40 atletas fueron seleccionados al azar como voluntarios para la investigación, divididos en grupo control y experimental, practicaron el mismo tipo de ejercicio físico y con la misma intensidad. Los atletas del grupo experimental tomaron alimentos siguiendo estrictamente la mezcla de alimentos descrita en el artículo, mientras que el grupo de control mantuvo su dieta habitual sin cambios. Tras el experimento, se llevó a cabo una sesión de entrenamiento deportivo, seguida de la medición de la enzima creatina muscular y el análisis de laboratorio de la urea en sangre. Estos datos se compararon y analizaron con los anteriores al experimento. **Resultados:** Tras ajustar la estructura dietética, los índices de CK y Bu de los atletas del grupo experimental mostraron una tendencia descendente, lo que indica que el ajuste de la estructura nutricional puede mejorar eficazmente la fatiga post-entrenamiento de los atletas universitarios.



Conclusión: Se recomienda que los profesores de educación física y los entrenadores universitarios ajusten el estilo de vida y la estructura nutricional de acuerdo con la situación real de los estudiantes, con el objetivo de promover el desarrollo integral y la mejora del rendimiento deportivo. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Nutrición en el Deporte; Educación y Entrenamiento Físico; Fatiga Muscular.

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INTRODUCTION

Sports fatigue is a common situation in sports training. College athletes will reach a relatively tired state during sports training. This kind of fatigue can promote the recovery of all aspects of athletes' physical functions to a certain extent, so as to gradually improve the upper limit of athletes' physical ability, promote their physical development and enhance their competition results.¹ Therefore, moderate training fatigue athletes have a positive effect, but in the current sports training, there is often excessive fatigue. At this time, sports fatigue has exceeded the critical value, and the positive impact on athletes becomes smaller, while the negative impact such as strain, sudden death and other risks increase.² Therefore, some methods should be adopted to alleviate the physical training fatigue of college athletes, so that the training fatigue can be controlled within the range of positive influence.³ Relevant experts have analyzed this. According to the literature, the performance of athletes' fatigue is multifaceted. In addition to showing muscle soreness, it can also produce such symptoms as panic, asthma, loss of appetite, endocrine disorders, dizziness, headache and so on.⁴ According to the literature, sports fatigue of athletes includes physical fatigue and psychological fatigue. Physical fatigue refers to the fatigue of the body caused by the rapid metabolism of muscles during sports. Psychological fatigue refers to the central fatigue caused by the high nervous tension and the increase of the proportion of nerve energy consumption in order to maintain good resistance during sports.⁵ According to the literature, the parts of fatigue in the process of physical training include muscle fiber, motor nerve fiber, muscle, cortical center, synapse and so on. The main parts of fatigue caused by different sports are different. Therefore, it is necessary to analyze the actual situation of sports when alleviating sports fatigue.

Athletes' daily life is an important branch that affects their sports performance. However, at present, for college athletes, they can not customize the nutrition plan by a special nutritionist like professional athletes. They often match their diet according to their own conditions under the guidance of nutritionists, which leads to the deviation of nutrition intake in College athletes' diet, which also has a certain impact on Athletes' physical training fatigue.⁶ Therefore, this paper starts with the nutrition intervention of college athletes to explore the effect of nutrition intervention on alleviating physical training fatigue.

METHOD

Selection of research objects

In order to obtain a relatively comprehensive result, during the nutrition intervention, a specific sport type was not selected. Instead, 40 participants were selected from the sports athletes of sophomores and juniors in Colleges and universities in the form of unlimited majors. They were randomly divided into the experimental group and the control group. The athletes in both groups have certain nutritional intake deviation, and are currently in good health. They did not take drugs one month before the experiment and during the experiment. Within the expectation of the experiment, the athletes can carefully complete their daily diet according to the nutrition plan of the researchers

Acquisition of basic data

The acquisition of basic data includes the current nutritional intake of college athletes and physical training fatigue. Among them, the athletes' nutrition intake was obtained by recall method and statistical method, and the physical training fatigue was obtained by experimental method.

The measurement of physical training fatigue is that before the nutrition intervention, the athletes carry out physical training, collect blood before and after the training respectively, and measure the content of creatine kinase and blood urea in the blood, so as to analyze the changes of the two indicators before the experiment and take them as the basis for judging training fatigue.

Experimental design

In this experiment, the way of control experiment was adopted. After analyzing the diet structure of the experimental group, the nutritionist matched the food according to the recommended intake. The study and all the participants were reviewed and approved by Ethics Committee of Ocean University of China (NO.OUCA2019-PY177B). The athletes in the experimental group took food in strict accordance with the relevant food mix, while the control group kept their original diet structure unchanged, and the nutritionist did not provide any suggestions. In addition, the experimental group and the control group maintained the same routine training. At the end of the experiment, exercise training was carried out, and the creatine muscle enzyme and blood urea content after training were measured, and compared with the data measured before the experiment.

RESULTS

Analysis of current nutritional intake of college athletes

When analyzing the nutritional intake of college athletes, some basic nutrients were selected, including three major nutrients, vitamins and inorganic salts. These three main types are closely related to the athletes' sports. The specific nutritional intake and recommended supply are shown in Table 1, Table 2 and Table 3.

Table 1 shows the intake of the three major nutrients. Carbohydrate, fat and protein are the substances that maintain the normal life

Table 1. Comparison of daily intake of three major nutrients per person and recommended supply.

Nutrient	Intake	Recommended supply	Intake / recommended supply standard
Sugar	312.055	640	48.76%
Protein	147.819	140	105.59%
Fat	178.193	120	148.49%

Table 2. Daily intake of various vitamins per person.

Nutrient	Intake	Recommended supply	Intake / recommended supply standard
Vc(Mg)	80.548	150-200	46.03%
VB1(mg)	1.221	3-6	29.07%
VB2(mg)	1.762	2.5	70.47%

Table 3. Daily intake of various inorganic salts per person.

Nutrient	Intake	Recommended supply	Intake / recommended supply standard
Sodium (mg)	5571.292	< 8000	69.64%
Potassium (mg)	2411.763	3000-4000	68.91%
Iron (mg)	37.625	20-25	167.22%
Calcium (mg)	526.972	1000-1200	47.91%
Magnesium (mg)	398.087	400-500	88.46%
Phosphorus (mg)	1,580.131	2000-2500	70.23%
Copper (mg)	4.294	3.5	122.69%
Zinc (mg)	38.111	20-25	169.38%
Selenium (mg)	129.184	50-150	129.18%

function of athletes. It can be seen from the table that the athletes' intake of sugar is low, only half of the recommended supply, which has a certain impact on the athletes' sports meeting and leads to problems in energy supply. In addition, the lack of necessary sugar can lead to liver function damage, which is not conducive to the improvement of athletes' physique. The athletes' protein intake is almost consistent with the recommended supply, which can meet the daily needs, but the fat intake is much higher than the recommended supply, which is related to the athletes' current diet structure. In order to get a lot of energy, athletes will eat a variety of meat, eggs and milk, which will lead to an increase in fat intake. The necessary fat content can store good physical fitness and facilitate continuous supply during exercise, but excessive fat intake will lead to fat accumulation in organs, which is not conducive to the health of athletes.

Table 2 shows the intake of vitamins. Here, vitamin E and vitamins B1 and B2 are taken as examples. Vitamin C is a highly effective antioxidant, which plays a good role in the oxidation-reduction reaction in the body. It can effectively improve exercise fatigue, promote element absorption, and treat anemia. However, the low intake of vitamin C in athletes may be related to the fact that athletes do not like to eat fruits and vegetables, which needs to be adjusted. Vitamin B1 is directly related to glucose metabolism and can maintain the functions of the heart, nerves and digestive system. The human body cannot directly produce vitamin B1, but can only obtain it from foods such as rice bran and bran. However, the current intake of vitamin B1 for athletes is only less than 30% of the recommended supply, which is also related to the current refined food. The proportion of seed coat and germ in food decreased, so the intake of vitamin B1 decreased. Vitamin B2 has an important effect on biological oxidation-reduction. It can strengthen liver function, regulate adrenaline secretion, reduce visual fatigue and promote eye development. Vitamin B2 mostly exists in eggs, milk, vegetables and animal liver. It can be seen from table 2 that although the current intake of vitamin B2 is low, it is higher than that of other vitamins.

Table 3 shows the intake of inorganic salts. The content of inorganic salt in human body is low, but it plays an important role. From the analysis of the proportion of intake and supply, it can be seen that athletes' intake of iron, copper, zinc and selenium is high, which is related to athletes' high intake of animal food. The intake of sodium, potassium, calcium, magnesium, phosphorus and other inorganic salts is low. The main sources of these inorganic salts are fruits, vegetables and coarse grains. Therefore, the diet structure of athletes needs to be further adjusted.

Analysis on the fatigue of college athletes in physical training

In order to study the effect of nutrition intervention on alleviating the physical training fatigue of college athletes, we must first analyze the physical training fatigue, as shown in Figure 1 and Figure 2.

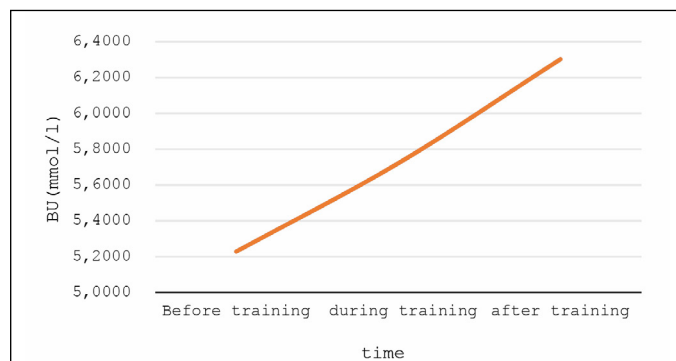
The changes of creatine kinase (CK) during training are shown in Figure 1. CK mainly exists in cytoplasm and fine-grained body, and is closely related to energy supply. The energy movement of cells, the contraction of related muscles and the regeneration of ATP are closely related to them, so they can be used as an important index to judge exercise fatigue. As can be seen from Figure 1, the number of athletes before training is about 120, rising steadily during the training process, and reaching about 220 after training.

The changes of blood urea (BU) during training are shown in Figure 2. Blood urea is the end product of protein metabolism. Through the determination of blood urea content, the protein metabolism during training can be analyzed. As can be seen from picture 2, the blood urea content before training was about 5, and after training it reached more than 6.2.

Through comprehensive analysis of Figure 1 and Figure 2, it can be seen that both protein metabolism and carbohydrate metabolism increase during exercise training, resulting in the accumulation of metabolites and exercise fatigue.

Effect of nutrition intervention on alleviating physical training fatigue of college athletes

Table 4 shows the changes of biochemical indexes of athletes before and after nutrition intervention. The results show that by adjusting the nutritional structure of athletes, the biochemical indexes after exercise can be effectively reduced, so as to achieve a good effect of reducing fatigue.

**Figure 1.** Changes of CK index during physical training of college athletes.**Figure 1.** Changes of Bu index during physical training of college athletes.**Table 4.** Changes of biochemical indexes of athletes before and after nutrition intervention.

Group	Before nutrition intervention	Nutrition intervention	
	Control group	220.436±68.778	228.207±57.637
Test group	226.002±80.290	202.791±42.753	
BU(mmol/l)	Control group	6.529±0.759	6.571±0.867
	Test group	6.328±0.665	5.555±0.703

DISCUSSION

Creatine kinase (CK) is limited by the cell membrane in daily life, and often exists in cells. The content of CK in serum is limited. However, when exercise fatigue occurs, the content of CK in serum will increase. There are many reasons. However, the current accepted principle is that high-intensity exercise causes muscle cell damage, so the cell membrane structure is damaged or the permeability is enhanced, resulting in the loss of a variety of enzymes in the cell membrane, including CK, into the serum. Therefore, the change of CK content in cells can be used as an index to judge exercise fatigue. The high-intensity CK content indicates that the muscle has suffered a lot of stimulation, and the skeletal muscle cells have been slightly damaged. Therefore, effective training must be carried out to recover from fatigue, otherwise it will inevitably lead to the strain of muscle and related tissues.

Blood urea (BU) reflects the degree of protein degradation. Its change is related to many factors. The increase of Bu content and blood concentration will increase its concentration. In the process of exercise, through the oxidative decomposition of muscle amino acids, the amino metabolism is increased, and the content of blood urea is increased. The large amount of water loss caused by exercise will also bring changes in blood concentration. When the weight of solution decreases and the weight of solute increases, the concentration of solute, that is, Bu, will be increased to a certain extent. Therefore, bu content can also be used as the key point to judge exercise fatigue.

In this study, we can see that athletes have a certain understanding of the nutritional structure, but the understanding is not sufficient. For example, they know that meat is a good material for energy supply, which can also improve the physical basis of the body. However, the lack of awareness of the proportion of food leads to insufficient intake of

vegetables and fruits and excessive intake of meat, which has a negative effect and is not conducive to the development of long-term physical fitness. This also provides a certain warning for physical education teachers. In the teaching process, we should not only pay attention to the teaching of athletes' theoretical knowledge of sports skills, but also pay attention to the management of their practical application of theoretical knowledge, so as to prevent students from blindly designing their own diet and living habits, thereby affecting their own physical development. Therefore, physical education teachers should regularly communicate on students' dietary structure and living habits, timely analyze and guide the problems existing in students' daily life, and prevent students from affecting their sports level due to the practical deviation of theoretical knowledge.

CONCLUSION

The results show that strengthening athletes' nutrition intervention can not only improve athletes' diet structure, promote their healthy growth, prevent diseases caused by nutrient deviation, but also promote the improvement of athletes' sports ability, so it is worth promoting. Coaches and physical education teachers should also strengthen the cognition of athletes' living habits and dietary structure in their daily work, and guide the wrong behaviors in time, so as to promote the all-round development of athletes and improve their sports performance.

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