

AEROBIC AND ANAEROBIC EXERCISE ABILITY OF ATHLETES COMBINED WITH BALANCED NUTRITION

CAPACIDADE DE EXERCÍCIO AERÓBICO E ANAERÓBIO DE ATLETAS COMBINADA COM NUTRIÇÃO EQUILIBRADA

EFFECTOS COMBINADOS DE UNA NUTRICIÓN EQUILIBRADA EN LA CAPACIDAD DE LOS ATLETAS PARA REALIZAR ACTIVIDADES AERÓBICAS



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Heweij¹
(Public Health)
A.N.Tambovskij²
(Basic Medicine)

1. Jiangsu normal university kewen college, Jiangsu, Xuzhou, China.
2. Moscow State Academy of Physical Culture, Malakhovka, Moscow Oblast, Rússia.

Correspondence:

Jiangsu, Xuzhou, 221116, China.
lw73961@21cn.com
zr16148@21cn.com

ABSTRACT

Balanced nutrition is very important for athletes' health and competition performance, and balanced nutrition has become a hot topic in the sports industry. In this study, 30s anaerobic work test and maximal oxygen uptake test were used to test anaerobic exercise ability and aerobic exercise ability, respectively. Four groups were set up in the two test methods, and the corresponding functional test indexes, heart rate recovery index and blood lactic acid recovery value were determined. The anaerobic capacity test showed that the maximum power of male athletes in the experimental group had significant statistical difference before and after dietary balance management, and the fatigue index of female athletes in the experimental group had a significant downward trend. Five minutes and nine minutes after exercise, the blood lactic acid value of males in the experimental group was lower than before balanced nutrition. The aerobic capacity test showed that the exhaustion time of male athletes in the experimental group was significantly different before and after balanced nutrition. After the balanced nutrition, the blood lactic acid value of male athletes in the experimental group was lower than before the management immediately and nine minutes after exercise, and the heart rate value of the male athletes in the experimental group was far lower than before the management.

Keywords: Diet, Food, and Nutrition; Exercise; Metabolism; Lactic Acid; Heart Rate.

RESUMO

Uma alimentação balanceada é muito importante para a saúde e o desempenho dos atletas em competições, tendo se tornado um tema bastante debatido no setor esportivo. Neste estudo, foram utilizados testes anaeróbios de 30 segundos e o teste de captação máxima de oxigênio para testar a capacidade de exercício anaeróbio e a capacidade de exercício aeróbio, respectivamente. Foram criados quatro grupos nos dois métodos de teste, e foram determinados os índices de teste funcional, o índice de recuperação da frequência cardíaca e o valor de recuperação do ácido láctico no sangue. O teste de capacidade anaeróbia mostrou que a potência máxima dos atletas masculinos do grupo experimental apresentava diferença estatística significativa antes e depois da administração de alimentação balanceada, e o índice de fadiga dos atletas do grupo experimental apresentava uma tendência descendente significativa. Cinco minutos e nove minutos após o exercício, o valor do ácido láctico no sangue dos homens do grupo experimental mostrou-se inferior ao valor anterior à alimentação balanceada. O teste de capacidade aeróbica mostrou que o tempo de esgotamento dos atletas masculinos no grupo experimental mostrou-se significativamente diferente antes e depois da administração de alimentação balanceada. Após a administração de alimentação balanceada, o valor do ácido láctico no sangue dos atletas masculinos no grupo experimental foi menor do que aquele antes da administração de alimentação balanceada imediatamente e nove minutos após o exercício, e o valor da frequência cardíaca dos atletas masculinos no grupo experimental foi muito menor do que o valor anterior à administração de alimentação balanceada.

Descritores: Alimentos, Dieta e Nutrição; Exercício aeróbio; Metabolismo; Ácido Láctico; Frequência Cardíaca.

RESUMEN

Una alimentación balanceada es muy importante para la salud y el desempeño de los atletas en competencias, habiéndose vuelto un tema bastante debatido en el sector deportivo. En este estudio, fueron utilizados tests anaeróbicos de 30 segundos y el test de captación máxima de oxígeno para verificar la capacidad de ejercicio anaeróbico y la capacidad de ejercicio aeróbico, respectivamente. Fueron creados cuatro grupos en los dos métodos de test, y fueron determinados los índices de test funcional, el índice de recuperación de la frecuencia cardíaca y el valor de recuperación del ácido láctico en la sangre. El test de capacidad anaeróbica mostró que la potencia máxima de los atletas masculinos del grupo experimental presentaba diferencia estadística significativa antes y después de la administración de alimentación balanceada, y el índice de fatiga de los atletas del grupo experimental presentaba una tendencia descendente significativa. Cinco minutos y nueve minutos después del ejercicio, el valor del ácido láctico en la sangre de los hombres del grupo experimental se mostró inferior al valor anterior a la alimentación balanceada. El test de capacidad aeróbica mostró que el tiempo de agotamiento de los atletas masculinos en el grupo experimental



se mostró significativamente diferente antes y después de la administración de alimentación balanceada. Después de la administración de alimentación balanceada, el valor del ácido láctico en la sangre de los atletas masculinos en el grupo experimental fue menor que aquel antes de la administración de alimentación balanceada inmediatamente y nueve minutos después del ejercicio, y el valor de la frecuencia cardíaca de los atletas masculinos en el grupo experimental fue mucho menor que el valor anterior a la administración de alimentación balanceada.

Descriptores: Alimentos, Dieta y Nutrición; Ejercicio aeróbico; Metabolismo; Ácido Láctico; Frecuencia Cardíaca.

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INTRODUCTION

The scientific training of athletes is based on balanced nutrition. Carbohydrate, protein, fat, vitamins, minerals, dietary fiber and water are the seven major nutrients of human metabolism.¹ In general, athletes always carry out high-intensity training in hot and cold environment, so it is extremely necessary to carry out professional nutrition management and supervision for athletes. In order to ensure the dynamic balance between the nutritional needs and energy consumption of athletes, it is necessary to scientifically arrange the diet structure and quantity according to the athletes' own events, gender, age, competition intensity and so on, so as to provide balanced, comprehensive and scientific nutrition.² Athletes' balanced diet should be based on the six major balance of diet to determine the proportion of food types, and fixed time and quantitative diet. For the balance of heat source quality and calorie ratio, the calorie proportion of carbohydrate, protein and fat of the three major nutrients of athletes every day is 50% - 60%, 25% - 30% and 12% - 15%, respectively. The heat of high-quality protein is not less than 30% of total protein energy. Endurance athletes can appropriately increase the proportion of carbohydrate.³ For amino acid balance, the edible nutrients ensure the proportion and quantity of eight essential amino acids. At the same time, limit the intake of high calorie foods such as butter and fried food. The intake of trace elements and microorganisms can meet the basic needs, and trace elements can be supplemented timely.⁴ The proportion of energy intake in breakfast, lunch, dinner and extra meal was 25% - 30%, 30% - 35%, 30% - 35% and 5% - 10%. At the same time, aerobic exercise ability and anaerobic exercise ability are the basis to measure the comprehensive ability of athletes. Among them, aerobic exercise is a kind of extreme exercise with increasing load. Aerobic exercise is mainly used in the front part and anaerobic exercise in the latter part. In view of the fact that there are few studies on the effects of balanced nutrition on aerobic and anaerobic exercise ability, this study proposes two test methods respectively.

In this study, two groups of experiments were set up: anaerobic group and aerobic group, respectively. 30 s power bicycle was used to test anaerobic exercise ability, and three test indexes including anaerobic exercise index, lactic acid metabolism index and heart rate recovery index were determined. Combined with the maximum oxygen uptake test with increasing load and gradient, the aerobic exercise ability was analyzed and the exercise ability index and lactic acid metabolism were determined. The effects of balanced nutrition on anaerobic and aerobic exercise capacity were analyzed by SPSS statistical software.

In view of the athletes' aerobic exercise ability and anaerobic exercise ability, this research innovation proposed to set up two groups of experiments: anaerobic group and aerobic group, each group of experiments were divided into experimental group male, experimental group female, control group male, control group female four groups, the experimental group through four weeks of balanced diet management, the control group normal diet. This comparative analysis method is helpful to analyze the data with large differences, and the comparison between men and women increases the accuracy of the experiment.

RELATED WORK

Kullen C In view of the fact that balanced nutrition is related to the health and combat status of military personnel, j et al. Proposed an evaluation method for general nutritional knowledge and dietary quality of military personnel. The correlation test and logistic regression showed that the nutritional knowledge of military officers was generally better than that of ordinary soldiers. Nutrition knowledge was negatively related to the age of military personnel, and had no obvious relationship with education level and life arrangement. There was a significant positive correlation between the data of general nutritional knowledge assessment and dietary quality assessment.⁵ Rao K M team used a shared system to analyze the nutritional status and death causes of tribal people in view of a large number of malnourished, high incidence rate and high mortality in a tribe in India. The results showed that the intake of food and nutrients was lower than recommended level. The causes of death were closely related to low birth weight.⁶ Hernandez et al. proposed a balanced diet program to manage the health of pregnant women and infants in view of gestational diabetes mellitus as a major disease threatening the health of pregnant women and infants. The results showed that balanced nutrition intake can alleviate insulin resistance of maternal adipose tissue and is conducive to normal metabolism of pregnant women and infants.⁷ Based on the fact that balanced nutrition of athletes can realize energy supply and nutrient demand, aughan team summarized the nutrition management scheme of athletes, and provided reference suggestions for diet management of athletes.⁸

To sum up, balanced nutrition is closely related to human health, and athletes' balanced nutrition diet is closely related to athletes' performance. At the same time, the anaerobic exercise ability and aerobic exercise ability of athletes have been widely studied in recent years. However, the exploration of balanced nutrition in aerobic and anaerobic exercise ability of athletes is relatively scarce. Based on previous studies, this study proposed a new test method, and verified the effectiveness of the method through experiments.

EXPERIMENTAL DESIGN AND ANALYSIS

Test results of anaerobic exercise ability of athletes

The maximum power, average anaerobic power and fatigue index of the experimental group and the control group before and after four weeks of balanced nutrition are shown in Figure 1 (a), 1 (b) and 1 (c). A1 and A2 were expressed in male of experimental group and male of control group, B1 and B2 of female of experimental group and control group respectively. The time before and after balanced diet was expressed by I and II respectively. From the maximum power, it can be seen that the experimental group of male athletes before and after the balanced diet data have significant statistical difference, but compared with the control group before and after the normal diet, there is no significant difference, which shows that the balanced diet has a certain improvement on the maximum efficiency of anaerobic work. In terms of average power, there is no significant difference between male athletes and female athletes in the experimental group, which indicates that balanced nutrition

can not improve the average anaerobic power. From the fatigue index, we can see that the data of experimental group female athletes after balanced diet management has a significant downward trend, but there is no significant statistical difference compared with the control group, which shows that balanced nutrition can effectively improve the fatigue status of athletes.

The changes of blood lactic acid in experimental group and control group with time are shown in Figure 2 (a) shows the blood lactic acid curve of the experimental group before and after balanced nutrition. The blood lactate value of men in the experimental group at 5 minutes after exercise is lower than that before four weeks, with significant statistical difference. The blood lactic acid value of men in the experimental group at 9 minutes after exercise is significantly lower than that before four weeks, with significant statistical difference. The blood lactic acid curve of the control group was significantly different from that of the control group under the four week balanced management. Figure 2 (c) shows the blood lactate curve of the experimental group before and after balanced nutrition, without statistical difference; Figure 2 (d) shows the blood lactate curve of the experimental group and the control group after balanced nutrition management, with no statistical difference. After balanced nutrition management, the clearance efficiency of blood lactic acid in the experimental group decreased significantly compared with

that before the management, and the clearance efficiency of women in the experimental group after balanced nutrition management also showed a significant downward trend.

The heart rate index of anaerobic power recovery test is shown in Figure 3. Figure 3 (a) and figure 3 (b) respectively show the changes of heart rate recovery value of male and female athletes with time. After balanced nutrition management, the heart rate of men in the experimental group at 2min and 3min were lower than before, with significant statistical significance, and the heart rate recovery value of men in the experimental group at 1min, 2min and 3min were faster than that before balanced nutrition management, with significant statistical difference. There was no significant difference in heart rate between experimental group and control group before and after balanced nutrition management.

Test results of aerobic exercise ability of athletes

The maximum oxygen uptake of experimental group and control group before and after balanced nutrition is shown in Figure 4. The maximum oxygen uptake, exhaustion time and maximum heart rate are shown in Fig. 1 (a), 1 (b) and 1 (c). The results of maximal oxygen uptake and maximum heart rate showed that there was no significant statistical difference between the experimental group and the control group before and after

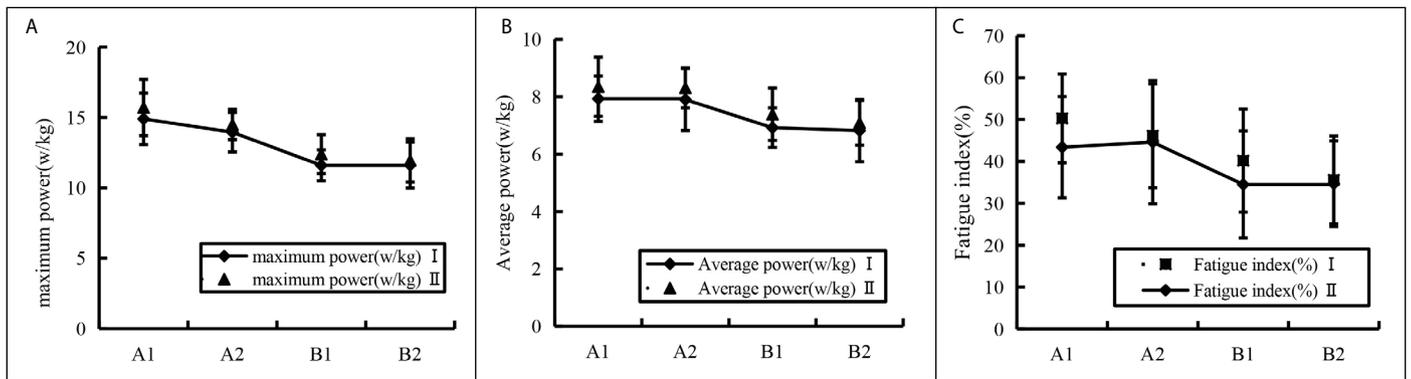


Figure 1. Anaerobic power results of experimental group and control group before and after four weeks of balanced nutrition.

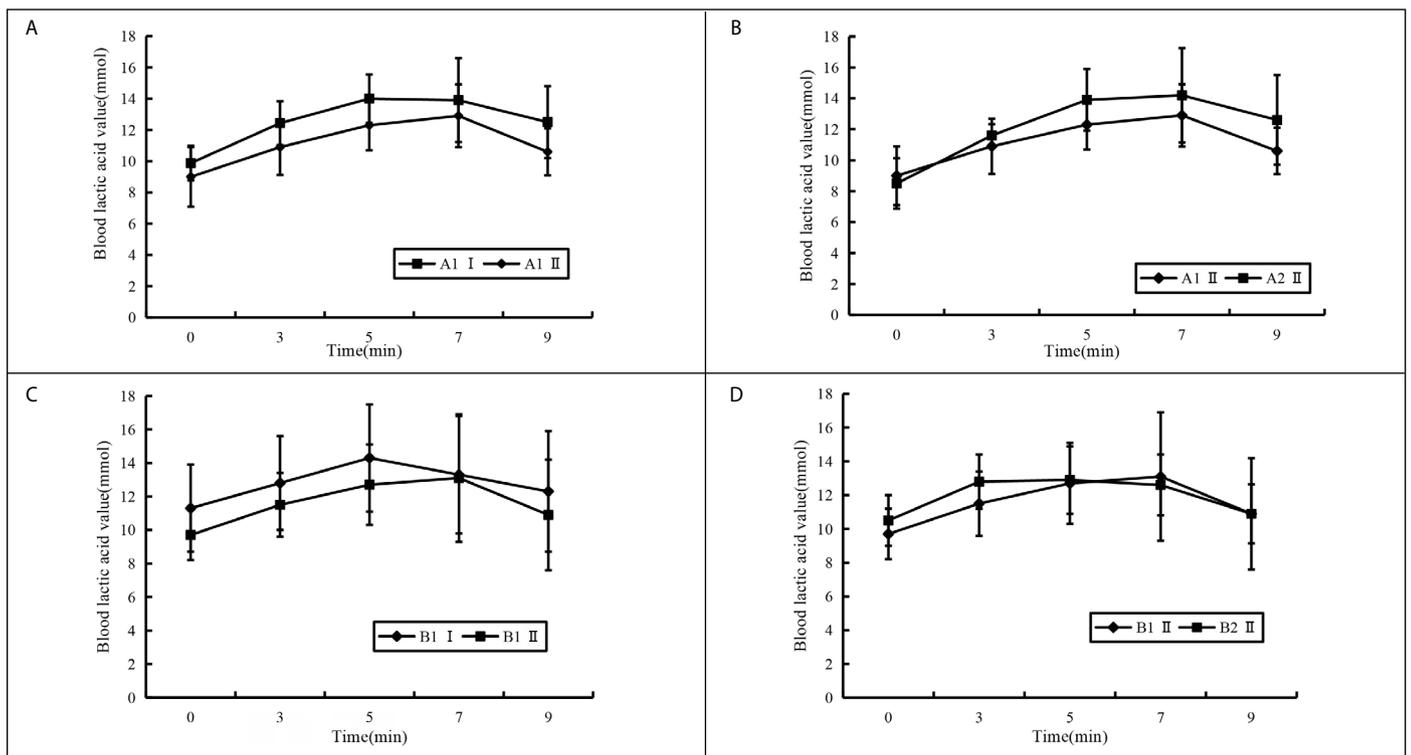


Figure 2. Changes of blood lactic acid in experimental group and control group.

self balanced nutrition. Exhaustion time showed that the exhaustion time of male athletes in experimental group after balanced nutrition was longer than that before balanced nutrition, with significant statistical difference.

The changes of blood lactic acid in experimental group and control group with time are shown in Figure 5 (a) shows the blood lactic acid curve of male athletes in the experimental group before and after balanced nutrition. The blood lactic acid value of the experimental group men immediately after the exercise is lower than that of four weeks ago, and the data has significant statistical difference. The blood lactic acid value of the experimental group men at 9 minutes after the end of the exercise is significantly lower than that before four weeks, and the data has a very significant statistical difference. Figure 5 (b) shows the blood lactic acid curve of the experimental group and the control group after balanced nutrition management. There is significant statistical difference between the experimental group and the control group under four week balanced management. Figure 5 (c) shows the blood lactate curve of the experimental group before and after balanced nutrition, without statistical difference; Figure 5 (d) shows the blood lactate curve of the experimental group and the control group after balanced nutrition management, with no statistical difference. After balanced nutrition management, the clearance efficiency of blood lactic acid in the experimental group decreased significantly.

The heart rate index of VO₂max recovery test is shown in Figure 6. Figure 6 (a) and Figure 6 (b) respectively show the change of heart rate recovery value of male athletes with time. After balanced nutrition management, the heart rate of men in the experimental group was far lower than that before the management, with very significant statistical significance. After balanced diet, the heart rate recovery value of men in the experimental group was lower than that in

the control group after normal eating, with significant statistical difference. There was no significant difference in heart rate between experimental group and control group before and after balanced nutrition management.

CONCLUSION

As balanced nutrition has become a health topic of common concern of the whole people, this study proposes to analyze the aerobic and anaerobic exercise ability of athletes by combining balanced nutrition, 30s anaerobic power test and maximum oxygen uptake test. The athletes are divided into anaerobic group and aerobic group by experimental test method, and the corresponding test recovery index is determined. Anaerobic work test shows that the maximum power of male athletes in the experimental group has significant statistical difference before and after the balanced diet management, and the fatigue index of female athletes in the experimental group has a significant downward trend. Compared with before self nutrition management and control group, the blood lactic acid value of male athletes in experimental group was lower. Compared with before self nutrition management and control group, the blood lactic acid value of female athletes in the experimental group had no significant difference. The results of maximal oxygen uptake showed that there was no significant statistical difference between the two groups before and after self balanced nutrition and between the experimental group and the control group. The exhaustion time of male athletes in experimental group after balanced nutrition was longer than that before balanced nutrition. The blood lactic acid value of male athletes in the experimental group was lower than that before balanced nutrition management, and there was no significant difference between the two groups before and after balanced nutrition. After

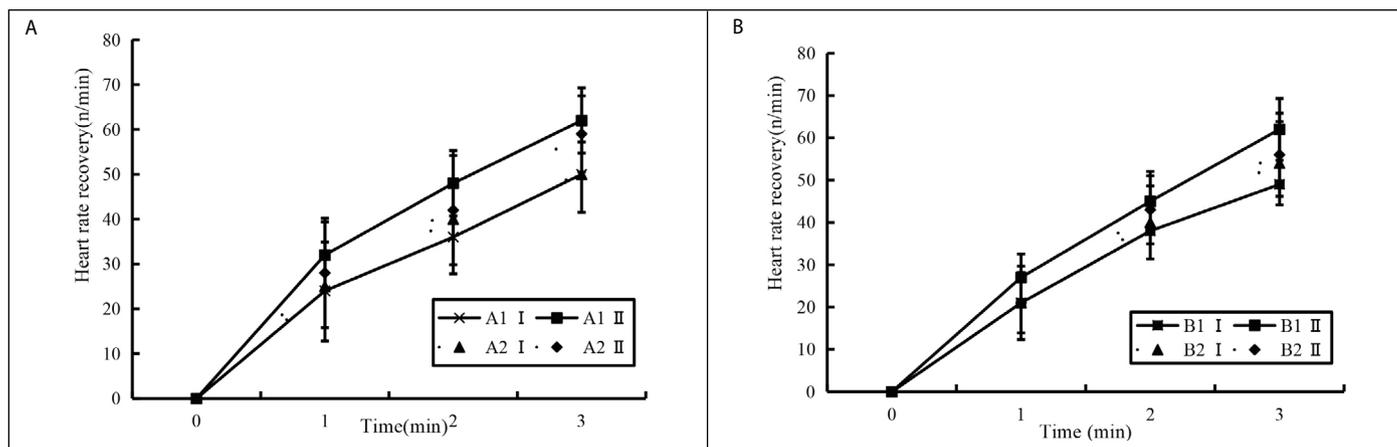


Figure 3. Changes of heart rate recovery value of male and female athletes with time.

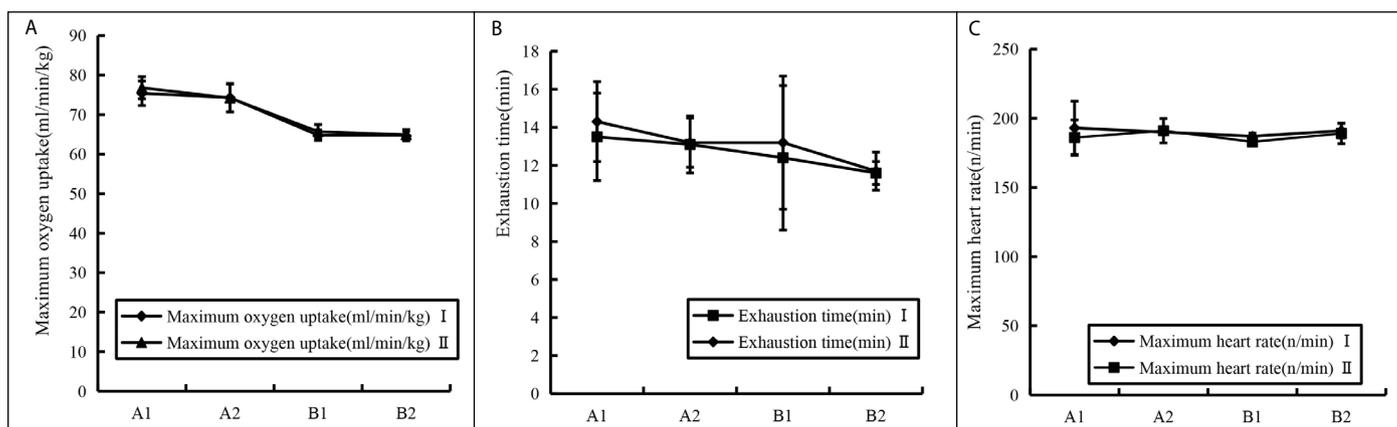


Figure 4. Maximum oxygen uptake test results of experimental group and control group.

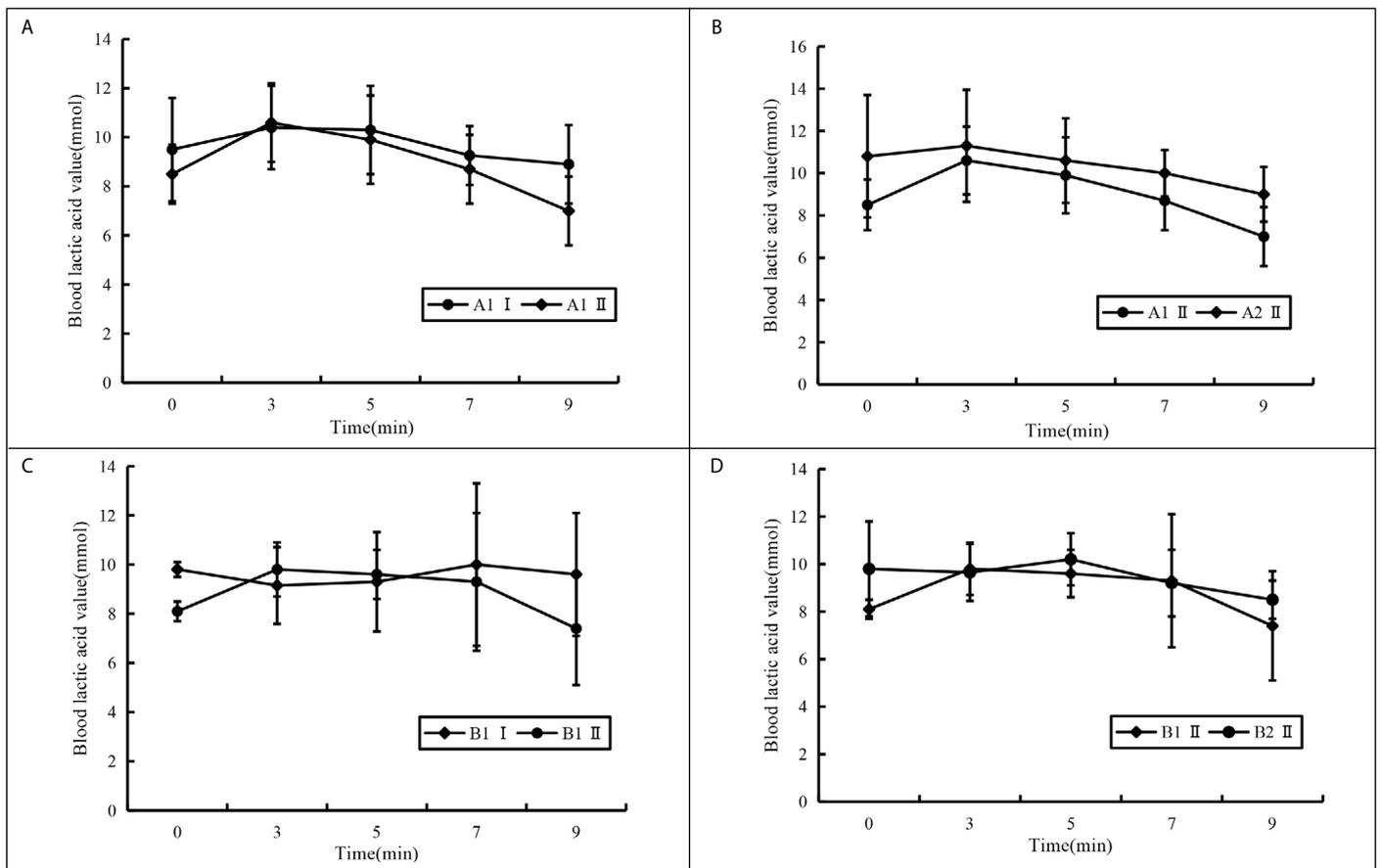


Figure 5. Changes of blood lactic acid in experimental group and control. group.

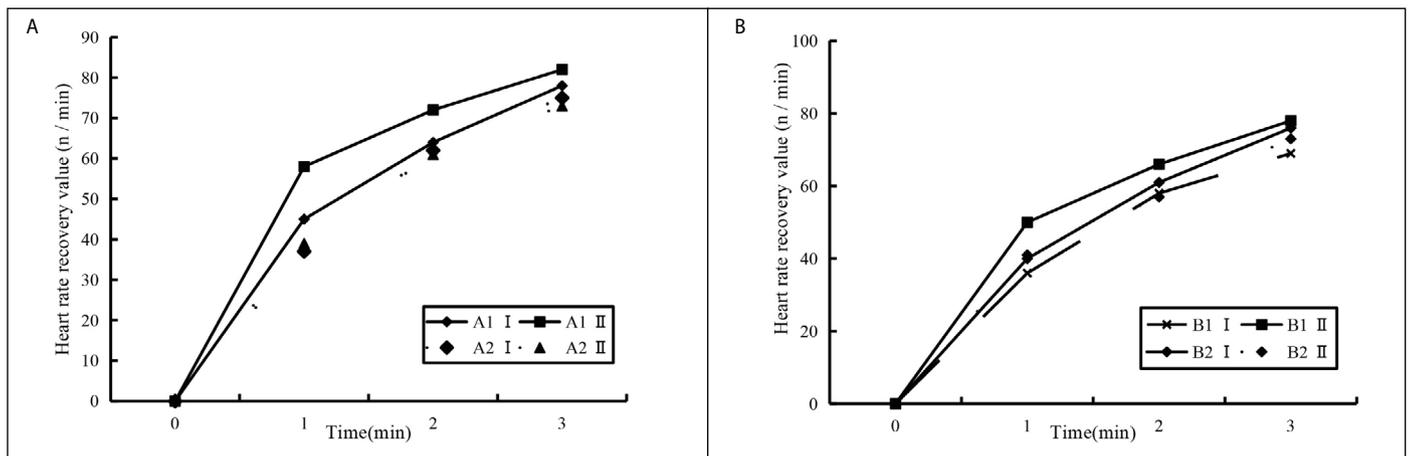


Figure 6. Heart rate index of VO₂max recovery test.

balanced nutrition management, the heart rate of men in experimental group was much lower than that before management. There was no significant difference in heart rate between experimental group and control group before and after balanced nutrition management. In view

of my limited energy, the research still needs to be improved, which is also the follow-up direction.

All authors declare no potential conflict of interest related to this article

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. A.N.Tambovs kij: writing and execution. Heweiqi: data analysis.

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