

EFFECTS OF DIETARY SUPPLEMENTATION ON THE TRAINING OF FEMALE TENNIS PLAYERS IN HOT CLIMATES



ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

EFEITOS DA SUPLEMENTAÇÃO DIETÉTICA SOBRE O TREINO DAS ATLETAS TENISTAS EM CLIMAS QUENTES

EFFECTOS DE LA SUPLEMENTACIÓN DIETÉTICA EN EL ENTRENAMIENTO DE LAS ATLETAS TENISTAS EN CLIMAS CÁLIDOS

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ABSTRACT

Introduction: A tennis match may last up to four hours with long intervals between moves of medium to high exercise intensity for 10 minutes and aerobic characteristic that requires specific sources of energy. Inappropriate diets can negatively impact sports performance and delay the recovery phase. Fortified wheat germ protein powder has the supplementation characteristics required in aerobic activities, although there are no practical studies on its impacts on the work performance of female tennis athletes. **Objective:** Explore the influence of two weeks of training in a warm environment combined with nutritional intervention on the performance of female tennis players. **Methods:** It was observed by testing the immunological indices of elite female tennis players while training their changes and their effects on nutritional intervention. **Results:** The increase in serum CK activity was closely related to the amount of exercise. Many studies have shown that serum CK activity increased significantly after strenuous exercise, and the serum CK value of subjects in the test group was significantly lower than that of the control group, showing better adaptability to exercise. Compared with before the nutritional intervention, the athletes' weight decreased slightly, and the body fat percentage decreased significantly after the nutritional intervention. Compared with before nutritional intervention, sugar and salt supplements in athletes were significantly increased ($P < 0.05$). Sweating rate, hydration rate, and hydration/sudden rate were also significantly increased ($P < 0.05$). **Conclusion:** Strengthening wheat germ protein supplementation may improve the nutritional albumin level in female tennis players, manifested in blood levels and immune function performance. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Clinical Trial; Tennis; Immunity.

RESUMO

Introdução: Partidas de tênis podem durar até quatro horas com intervalos longos entre jogadas de intensidade de exercício média a alta por 10 minutos, características aeróbicas que requerem fontes específicas de energia. Dietas inadequadas podem impactar negativamente o desempenho esportivo e retardar o período de recuperação. O pó de proteína de germe de trigo fortificado apresenta as características de suplementação requeridas nas atividades aeróbicas, embora não haja estudos práticos sobre seus impactos no desempenho profissional de atletas do tênis feminino. **Objetivo:** Explorar a influência no treinamento de duas semanas em ambiente quente combinado com a intervenção nutricional sobre o desempenho das atletas tenistas. **Métodos:** Ao testar os índices imunológicos das tenistas de elite durante o treinamento, observamos suas mudanças e seus efeitos na intervenção nutricional. **Resultados:** O aumento da atividade de CK sérico esteve intimamente relacionado à quantidade de exercício. Muitos estudos mostraram que a atividade do soro CK aumentou significativamente após o exercício extenuante, e o valor sérico CK dos sujeitos no grupo de teste foi significativamente menor do que o do grupo controle, mostrando melhor adaptabilidade ao exercício. Em comparação com antes da intervenção nutricional, o peso dos atletas diminuiu ligeiramente e o percentual de gordura corporal diminuiu significativamente após a intervenção nutricional. Em comparação com antes da intervenção nutricional, os suplementos de açúcar e sal em atletas foram significativamente incrementados ($P < 0,05$). A taxa de sudorese, a taxa de hidratação e a taxa de hidratação/sudorese também aumentaram significativamente ($P < 0,05$). **Conclusão:** Fortalecer a suplementação com proteína de germe de trigo pode melhorar o nível nutricional de albumina nas tenistas, manifestadamente nos níveis sanguíneos e desempenho da função imunológica. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Ensaio Clínico; Tênis; Imunidade.

RESUMEN

Introducción: Los partidos de tenis pueden durar hasta cuatro horas con largos intervalos entre jugadas de intensidad de ejercicio media a alta durante 10 minutos, características aeróbicas que requieren fuentes de energía específicas. Las dietas inadecuadas pueden afectar negativamente al rendimiento deportivo y retrasar el periodo de recuperación. La proteína de germen de trigo en polvo enriquecida presenta las características de suplementación requeridas en las actividades aeróbicas, aunque no existen estudios práticos sobre sus impactos en el rendimiento profesional de las



atletas de tenis. **Objetivo:** Explorar la influencia de dos semanas de entrenamiento en un ambiente cálido combinado con una intervención nutricional en el rendimiento de las atletas de tenis. **Métodos:** Mediante el análisis de los índices inmunológicos de las tenistas de élite durante el entrenamiento, observamos sus cambios y sus efectos en la intervención nutricional. **Resultados:** El aumento de la actividad de la CK en suero estaba estrechamente relacionado con la cantidad de ejercicio. Muchos estudios han demostrado que la actividad de la CK en suero aumenta significativamente después de un ejercicio extenuante, y el valor de la CK en suero de los sujetos del grupo de prueba fue significativamente menor que el del grupo de control, lo que demuestra una mejor adaptabilidad al ejercicio. En comparación con antes de la intervención nutricional, el peso de los atletas disminuyó ligeramente y el porcentaje de grasa corporal se redujo significativamente después de la intervención nutricional. En comparación con antes de la intervención nutricional, los suplementos de azúcar y sal en las atletas aumentaron significativamente ($P < 0,05$). La tasa de sudoración, la tasa de hidratación y la tasa de hidratación/sudoración también aumentaron significativamente ($P < 0,05$). **Conclusión:** El refuerzo de la suplementación con proteínas de germen de trigo puede mejorar el nivel nutricional de albúmina en las jugadoras de tenis, manifestándose en los niveles sanguíneos y en el rendimiento de la función inmunitaria. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptor: Ensayo Clínico; Tenis; Inmunidad.

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0180

Article received on 03/31/2022 accepted on 04/28/2022

INTRODUCTION

Tennis is an intermittent sport, including upper and lower limb muscles participating in explosive activities in a relatively short period of time, accompanied by a rest field. Tennis usually takes about 2 hours, sometimes even 4 hours, and the duration of hitting the ball back and forth for one point is 4 ~ 12 seconds.¹ However, the intensity of exercise is medium and high, and the time required for each game is short, generally about 10 minutes, and the interval time is long, so aerobic energy supply is the main factor. According to the questionnaire survey of a large sample of athletes, there are significant differences between excellent tennis players and low-level athletes in many dimensions of psychological skills. Excellent players have extremely strong psychological energy, and they usually have a "pleasant long experience" in the competition.^{2,3} If the diet is not supplemented in time, it will seriously affect the fatigue elimination and the improvement of exercise ability after exercise. As a special group of special events, women tennis players should not only aim at the energy metabolism characteristics and nutritional needs of Wushu athletes, but also consider the special metabolic standards and energy consumption of women tennis players.

In view of this, in this paper, the fortified wheat germ protein powder added with branched chain amino acids and tyrosine was used as nutritional supplement, the blood biochemical indexes and immunological indexes of athletes before and after supplementation were detected, and the influence of the fortified wheat germ protein powder on athletes' nutritional status and immune function was discussed, which provided experimental basis for reasonable nutritional supplement of female tennis players.

Research objects and methods

Eighteen excellent female tennis players in a sports institute were investigated and tested, and the experimental research was carried out by using the cross experimental model. The study is Purely observational studies which no need to registry ID of ICMJE, and all the participants were reviewed and approved by Ethics Committee of Chengde Petroleum College of China (NO. 202015CPCEC, and). The test subjects were divided into nutritional supplement group and placebo group, with 9 players in each group. The basic physical training status of athletes is shown in Table 1.

Table 1. List of physical training status of elite female tennis players.

| Total number of people | Age | Height (cm) | Weight (kg) | Years of training |
|------------------------|------------|-------------|-------------|-------------------|
| 18 | 20.87±2.36 | 159.66±7.21 | 56.43±5.38 | 8.00±2.00 |

Literature data method

By searching the relevant literature, this paper collected and sorted out the literature about the nutrition needs and weight reduction and control of female tennis players, and read and analyzed the relevant literature, which provided theoretical basis for this study.

Logical analysis method

By using logical methods such as analysis and synthesis, induction and deduction, and comparative study, the obtained data are thought-processed, and the experimental data are analyzed and discussed.

Experimental method

Sports nutrition supplement measures: The principle of nutrition supplement is to supplement nutrition for athletes in the training process near the competition period twice a year according to the requirements of coaches and the test results of female tennis players, combined with the actual situation and competition arrangement.

Test indicators: blood biochemical indicators creatine kinase (CK), creatine kinase heart isoenzyme (CK-MB), blood urea (Bun) and serum protein (Hb), immune indicators IgG, IgA, CD3, CD4, CD8, CD48 and NK.

Dietary survey and monitoring: The athletes were investigated by weighing method. Accurately weigh and record the raw weight of various foods before cooking, the cooked weight after cooking and the remaining amount after meals, weigh and record the consumption of various foods per meal of athletes, and then calculate the daily intake of nutrients, the calorie ratio of three meals, the food sources and dietary composition of nutrients by using the software of "Dietary Nutrition Analysis and Management System for Athletes and the Public".

Statistical analysis

Statistical analysis was carried out with SPSS110 statistical software, all data were expressed as mean standard deviation, and variance analysis was carried out on the data, taking $P < 0.05$ as the significant level.

RESULT

Effect of nutritional intervention on immune indexes of female tennis players

The immune indexes of athletes taking fortifier and placebo were analyzed by multivariate variance, and the numerical changes of T lymphocyte subsets, immunoglobulins, creatine kinase (CK), creatine

kinase isoenzyme (CK-MB) and natural killer cells (NK) in peripheral blood between the two groups were observed. $P < 0.05$ is a significant difference.

Table 2 shows that there are significant differences in CK and IgG between the two groups of athletes taking fortifier and placebo. The increase of serum CK activity is closely related to the amount of exercise. Many studies have shown that the serum CK activity increases significantly after strenuous exercise. The CK activity of extreme intensity exercise can be increased to about 500~1000, and the increase of serum CK activity is not only related to the length of exercise, but also related to the intensity of exercise. The serum CK value of the subjects in the fortifier group was significantly lower than that in the placebo group, showing better exercise adaptability.

Body composition change

Table 3 shows that after nutrition intervention, athletes' body weight decreased slightly, the percentage of body fat decreased significantly by 4.5% ($P < 0.05$), and lean body weight increased significantly by 2.3% ($P < 0.05$).

Athletes' rehydration and sweating

Table 4 shows that compared with before nutrition intervention, the sugar and salt supplements of athletes with thousands of prognosis are significantly increased ($P < 0.05$). Sweating rate, hydration rate and hydration rate/sweating rate also increased significantly ($P < 0.05$).

DISCUSSION

A tennis match usually lasts for about 2 hours, sometimes even up to 4 hours. Sugar is a high-quality fuel for muscles in medium-intensity exercise which lasts for 2-3 hours for a long time. Intermittent exercise usually adopts combined training, which is a training method of repeated rest and cross-training, that is, between high-intensity exercise period

and exercise period, interspersed with low-intensity exercise or rest (rest period), and repeated training in multiple groups.⁴ With the improvement of competition level, athletes have almost the same skills and tactics. Competitive competition has become a psychological contest to a great extent, and it is more obvious at the critical moment. Therefore, how to get good physical fitness through scientific training is a key issue in this project. At the same time, due to the intensity of training, there are many problems in training and competition, such as sports anemia, sports hypoxemia, sports immunity and other medical problems.

Sports training is an effective measure to improve athletes' sports function, while balanced diet is the material basis to ensure athletes' nutritional needs and improve their sports ability, and it is also an important guarantee to improve training effect and eliminate fatigue.^{5,6} In the process of heat acclimatization, athletes are affected by high temperature, and the secretion of digestive juice such as saliva and gastric juice decreases, which leads to decreased appetite and weakened digestive function, and then easily leads to insufficient intake of heat energy and other nutrients.⁷ This is related to the single category of food supply in the dining restaurant of athletes and the fact that athletes pay attention to weight and reduce the intake of basic energy substances. Carbohydrate is the most ideal energy material. Adequate glycogen reserve in the body can reduce the oxidation utilization of protein and fat in training and competition, delay fatigue, especially keep endurance, speed and reaction ability in good condition in competition, which is necessary for female tennis players. On the contrary, insufficient energy intake will seriously affect the normal material metabolism and athletes' athletic ability.

Water swimming training adopts aerobic and anaerobic combination to lay a good foundation, and combined with the practice of this special project, it uses step-by-step training method to improve the speed endurance on the field. It improves the leg strength by confrontation, pushing and pressing, moving with weight, and folding left and right, and at the same time improves the flexibility and position feeling of individuals in the water. Literature⁸ found that there are differences in the most important psychological skills required by different age groups, but no matter which stage, the two psychological skills most mentioned by coaches are enjoyment (fun) and concentration. Literature⁹ has reached a similar result, and its research found that athletes with college level and Olympic level regard having fun as one of their first three goals. Under normal circumstances, the energy required by nerve tissue is mainly supplied by sugar oxidation. When vitamin B1 is insufficient, pyruvic acid is not easy to oxidize, which will easily lead to accumulation of pyruvic acid and lactic acid in the tissue, which will reduce the energy supply, affect the metabolism of nerve and muscle, and cause symptoms such as heavy lower limbs, rapid heartbeat and heart failure, thus affecting exercise ability.

The psychological training of tennis players is an educational process of consciously and purposefully cultivating, developing and perfecting various psychological qualities that must be possessed in tennis. From the changes of serum CK of female tennis players, it can be seen that the changes of serum CK of athletes fluctuate, but they are basically within the normal range, which is mainly due to the fact that the whole training process is mainly based on large amount of exercise, the exercise intensity is relatively small, and the rise of serum CK is not obvious. Protein is an essential nutrient for human body, and the repair and reconstruction of human tissues need protein to participate in muscle contraction, nervous system excitement transmission and other processes, which are also related to the intake of high-quality protein.¹⁰ Although most athletes' protein intake is in the normal range, it is close to the minimum recommended value. It is worth noting that it is of practical significance to supplement athletes with high-quality protein.

Table 2. Comparison of immune index parameters between fortifier and placebo group.

| index | Reinforcer | Placebo |
|---|-------------|---------------|
| Creatine kinase CK(u/1) | 81.02±34.96 | 120.24±67.82* |
| Creatine kinase heart-type isoenzyme CK-MB(u/1) | 9.66±3.25 | 9.33±3.81 |
| Immunoglobulin G(g/1) | 8.47±0.58 | 7.96±0.62* |
| Immunoglobulin A(g/1) | 0.66±0.21 | 0.77±0.26 |
| Total t lymphocyte CD3(%) | 70.21±8.33 | 70.28±6.99 |
| Helper T lymphocyte CD4(%) | 39.25±6.62 | 39.42±6.71 |
| Inhibitory T lymphocyte CD8(%) | 35.01±6.65 | 32.86±5.59 |
| Helper/suppressor T lymphocyte CD4/8(%) | 1.28±0.33 | 1.33±0.29 |
| Natural killer lymphocyte NK(%) | 12.58±5.19 | 10.28±4.17 |

Note: ** indicates that the comparison of different drugs taken by the same group of observation subjects is $P < 0.05$.

Table 3. Changes of athletes' body composition before and after nutrition intervention.

| Index | Before intervention | After intervention |
|-------------------------|---------------------|--------------------|
| Weight (kg) | 61.28±4.32 | 61.01±3.69 |
| Body fat percentage (%) | 23.08±3.90 | 21.09±22.71 |
| Lean body weight (kg) | 48.33±1.25 | 49.11±1.37 |

Table 4. Comparison of rehydration and sweating of transport workers before and after nutrition intervention.

| Index | Before intervention | After intervention |
|---|---------------------|--------------------|
| Sugar supplement amount (g) | 7.32±29.81 | 126.77±23.47 |
| Sweating rate (g/h) | 1988.71±170.25 | 2127.36±166.09 |
| Make-up rate (g/h) | 1208.02±139.66 | 1450.17±120.24 |
| Replenishing water Rate/sweating rate (%) | 61.59±9.93 | 70.25±8.83 |
| Salt supplement in training (g) | 0.71±0.46 | 2.88±1.25 |

When exercising in hot environment, energy metabolism is affected by both high temperature environment and exercise training. Reasonable energy supply ratio of protein, fat and carbohydrate is very important to exercise ability. Under the same training environment, athletes sweat ahead of time, sweat rate increases, sugar, salt and water supplement of athletes increase obviously, and water loss and salt deficiency are improved, which shows that athletes' heat acclimatization is ideal, and adaptive training improves athletes' heat tolerance. Through investigation, it was found that female tennis players had insufficient intake of vitamin B, vitamin A, vitamin C and vitamin PP. Vitamins have the function of regulating physiology and participate in energy metabolism. For female tennis players, long-term and intensive sports training leads to the loss of vitamin C. During training and competition, a large number of vitamins in the body are lost with the loss of sweat, which easily leads to the enhancement of free radical activity in the body.

CONCLUSION

Nutritional intervention improved the intake of heat energy and three nutrients of tennis players, and made their intake ratio tend to a reasonable recommended range. There were significant differences in hemoglobin (Hb), prealbumin (PRO), creatine kinase (CK) and immunoglobulin (IgG) between 18 subjects who took fortifier and placebo respectively, and the indexes of athletes who took fortifier were significantly higher than

those of placebo group. And the serum CK value is obviously lower than that of placebo group, so it has strong exercise adaptability. Scientific and reasonable functional monitoring and nutritional supplement can promote athletes' fatigue elimination. It can keep good physical function and physical fitness, and successfully implement the training plan of coaches. At the same time, the test results can also provide some reference for coaches to make training plans. Attention training is very important for tennis players. How to keep high-intensity concentration of attention for a long time and focus on a specific target range is the focus of training. Various kinds of noise simulation training, using non-judgmental thinking, using suggestive language and establishing operation procedures are all effective attention training methods at present. For example, operation set can concentrate attention and help athletes prepare for the upcoming competition.

ACKNOWLEDGEMENT

The study was supported by Tennis Sports Management Center of the State General Administration of Sports, Nutrition Management and Functional Monitoring of National Tennis Team Athlete.

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

AUTHORS' CONTRIBUTIONS: The authors have 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. HL: writing; GK and PL: Experiment design and Implementation

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