

ANALYSIS AND RESEARCH ON FITNESS BIOMARKERS IN VOLLEYBALL ATHLETES DURING COMPETITION



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ANÁLISE E PESQUISA SOBRE BIOMARCADORES DE CONDICIONAMENTO FÍSICO EM ATLETAS DE VÔLEI DURANTE COMPETIÇÃO

ANÁLISIS E INVESTIGACIÓN DE LOS BIOMARCADORES DE APTITUD FÍSICA EN ATLETAS DE VOLEIBOL DURANTE COMPETICIÓN

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ABSTRACT

Introduction: Athletes' physical conditioning is closely related to the type of sport dedicated, training levels, intrinsic conditions of the athletes, type of load, and recovery status after exercise training. There is ample documentation on the physical conditioning of volleyball athletes in normal situations, but the literature is lacking in surveys during competition periods. **Objective:** To explore the physical conditioning through analysis of body biomarkers in volleyball athletes in competition. **Methods:** Before and after the summer training, fasting urine and blood samples were collected from five female volleyball players. Biomarkers involving white blood cells, red blood cells, hemoglobin, etc., were detected, recorded, and the data were statistically analyzed. After the general analysis of the sample, a case study of two elite female athletes was conducted. **Results:** The urea nitrogen value of athlete A decreased from 7.62mmol/L to 4.91mmol/L, and the urea nitrogen value of athlete B decreased from 6.91mmol/L to 6.57mmol/L; the urea nitrogen values of both athletes showed a downward trend. Athlete A's physical function status decreased significantly after summer training, while Athlete B's physical function status improved slightly. **Conclusion:** During the summer training period, it is necessary to perform continuous index measurements on the athletes to increase the timeliness of the data, which is conducive to in-depth analysis of the athletes' fitness status. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Volleyball; Sports; Physical Conditioning, Human; Biomarkers.

RESUMO

Introdução: O condicionamento físico dos atletas está intimamente relacionado ao tipo de esporte dedicado, níveis de treinamento, condições intrínsecas das atletas, tipo de carga e status de recuperação após o treinamento dos exercícios. Há vasta documentação sobre o condicionamento físico dos atletas de vôlei em situações normais, porém a literatura deixa a desejar nos levantamentos durante o período de competições. **Objetivo:** Explorar o condicionamento físico através de análise de biomarcadores corporais nos atletas de vôlei em competição. **Métodos:** Antes e depois do período de treinamento de verão, foram coletadas amostras de urina e sangue, em jejum, de cinco jogadoras de vôlei feminino. Biomarcadores envolvendo glóbulos brancos, glóbulos vermelhos, hemoglobina, etc. foram detectados, registrados, e os dados foram analisados estatisticamente. Após a análise geral da amostra, foi realizado um estudo de caso de duas atletas de elite. **Resultados:** O valor de nitrogênio de ureia da atleta A diminuiu de 7,62mmol/L para 4,91mmol/L, e o valor do nitrogênio de ureia da atleta B diminuiu de 6,91mmol/L para 6,57mmol/L, os valores de nitrogênio da ureia de ambas as atletas apresentaram tendência de queda. O estado de função física da atleta A diminuiu significativamente após os treinos de verão, enquanto o estado de função física da atleta B melhorou ligeiramente. **Conclusão:** Durante o período de treinamento de verão, é necessário realizar uma medição contínua do índice sobre os atletas para aumentar a pontualidade dos dados, o que é propício à análise aprofundada do estado de condicionamento físico das atletas. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Voleibol; Esportes; Condicionamento Físico Humano; Biomarcadores.

RESUMEN

Introducción: El acondicionamiento físico de los deportistas está íntimamente relacionado con el tipo de deporte al que se dedican, los niveles de entrenamiento, las condiciones intrínsecas de los deportistas, el tipo de carga y el estado de recuperación tras los ejercicios de entrenamiento. Existe una amplia documentación sobre el acondicionamiento físico de los deportistas de voleibol en situaciones normales, pero la literatura deja mucho que desear en los estudios durante el periodo de competiciones. **Objetivo:** Explorar la condición física mediante el análisis de biomarcadores corporales en atletas de voleibol en competición. **Métodos:** Antes y después del periodo de entrenamiento de verano, se recogieron muestras de orina y sangre en ayunas de cinco jugadoras de voleibol. Se detectaron y registraron los biomarcadores relativos a los glóbulos blancos, los glóbulos rojos, la hemoglobina, etc., y los datos se analizaron estadísticamente. Tras el análisis general de la muestra, se realizó un estudio de casos de dos atletas de élite. **Resultados:**



El valor de nitrógeno ureico del atleta A disminuyó de 7.62mmol/L a 4.91mmol/L, y el valor de nitrógeno ureico del atleta B disminuyó de 6.91mmol/L a 6.57mmol/L, los valores de nitrógeno ureico de ambos atletas mostraron una tendencia a la baja. El estado de la función física del atleta A disminuyó significativamente después del entrenamiento de verano, mientras que el estado de la función física del atleta B mejoró ligeramente. Conclusión: Durante el período de entrenamiento de verano, es necesario realizar mediciones continuas de los índices en los atletas para aumentar la puntualidad de los datos, lo que favorece el análisis en profundidad del estado de forma física de los atletas.

Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.

Descriptor: Voleibol; Deportes; Acondicionamiento Físico Humano; Biomarcadores.

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INTRODUCTION

Volleyball players, as leaders of competitive sports and demonstrators of volleyball sports, have a great role in modeling and driving school sports, national sports and competitive sports, athletes in this project must have strong physique, quick response, keen judgment and good psychology, however, physical fitness is the foundation and fundamental of sports, and there is no shortcut to improve physical fitness, only by accumulating scientific training, systematic training, and skillful guidance can we truly become a volleyball player in the new era who can fight and win. Of course, as one of the three major sports, volleyball has different innate physiques, different training conditions, various training methods, and different degrees of popularity.¹ In response to this research question, Watson, A. et al. pointed out in their study: Volleyball is a technical and tactical-led team project in which both sides of the game confront each other, this is its essential feature, the conflict between offense and defense is the most basic law and feature of the movement.² Wang, W. et al believed that leukocytes are cells with a variety of immune function activities, which can protect the body from pathogens and are an important component of the body's immune function, it is often used as an effective indicator to observe the immune function of athletes.³ Tertuliano, I. W. and others believed that under normal body function conditions, serum testosterone is relatively stable and does not fluctuate much. However, there will be a more obvious trend of changes in serum testosterone with the change of physical function, when the physical function of the subjects is significantly improved through exercise, serum testosterone levels tend to increase significantly, on the contrary, when recipients are overtired, their physical functions decline, serum testosterone levels also decrease, so serum testosterone can more accurately reflect the effect of training on individual athletes.⁴

METHOD

Research object

Five female volleyball players who participated in the summer training center in the A Sports Bureau Training Center were selected as the research objects, the basic information is shown in Table 1.

Research methods

The summer training time is generally set from May to late July, before the summer training starts, the athletes are drawn blood to obtain the white blood cell count (WBC, normal range 4~10x10⁹/L), red blood cell count (RBC, normal range 4~6x10¹²/L). Hemoglobin value (HGB, normal range 120-160g/L) testosterone value (T, normal range 10-75ng/dl) hematocrit value (HCT, normal range 0.35-0.50), biochemical indicators such as creatine kinase value (CK, normal range 20~200U/L), blood urea

nitrogen value (BUN, normal range 1.7-8.3mmol/L) and serum cortisol value (C, normal range 6000~26000ng/dl).^{5,6} After the summer training, blood was drawn again, and the above indicators were obtained for comparison, through some changes in blood indexes before and after summer training of five volleyball players, we can judge whether the training volume of the players is appropriate.

The test method is as follows: There are mainly cyanide hemoglobin method (hemoglobin), enzyme-linked immunosorbent assay (testosterone), creatine colorimetric method (creatinase), diacetyl-oxime method (urea nitrogen), enzyme-linked immunosorbent assay (cortisol). The main testing instruments are: S22PC spectrophotometer (hemoglobin, creatinase, urea nitrogen), RT-2100C microplate reader (testosterone, cortisol),⁷ etc.

After the overall analysis of the sample, a case study of two elite athletes was conducted.

SPSS19.0 statistical software was used for comparison (p<0.05 has a significant difference), the data were tested by paired sample t test, and the results were expressed as $\bar{X} \pm S$.

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

RESULTS AND ANALYSIS

Results

Before and after the summer training cycle, fasting blood was collected from five female volleyball players, and white blood cells, red blood cells, hemoglobin, testosterone, hematocrit, creatinase, blood urea nitrogen, and serum cortisol were detected respectively, and the data were analyzed, as shown in Table 2.

Because the sample size is too small and the sample standard deviation is large, there is no significant difference in data analysis, but it can be seen from the experimental data that, the data changes before and after the summer training have obvious trends, so a case study of athletes A and B is carried out.

As can be seen from Table 3, before and after the summer training, the indicators of Athlete A were all within the normal range, after the summer training cycle, the white blood cell count (WBC), hemoglobin (HGB), and blood urea nitrogen (BUN) were significantly decreased, red blood cell value (RBC), testosterone value (T) and testosterone/cortisol value (T/C) decreased slightly, hematocrit value (HCT) increased slightly, creatinase value (CK) and cortisol value (C) markedly increased.

As can be seen from Table 4 and Figure 1, athlete B, before and after the summer training, all indicators are within the normal range, after the summer training cycle, creatinase value (CK) decreased significantly, testosterone value (T), blood urea nitrogen value (BUN) and testosterone/cortisol (T/C) value decreased slightly, the hematocrit value (HGB) was significantly increased, and the white blood cell value (WBC), red blood cell value (RBC), hemoglobin value (HCT) and cortisol value (C) were slightly increased.

Table 1. Basic information of five female volleyball players.

gender	N	age	height	weight	training years
Woman	5	22.6±3.4	178.6±5.6	65.9±5.8	12.4±0.8

Table 2. Comparison of the average values of various indicators before and after the summer training.

	WBC	RBC	HGB	T	HCT	CK	BUN	C
Before	6.67±1.54	4.54±0.39	133.3±8.97	40.68±3.18	0.38±0.05	172.7±79.47	6.34±0.94	30109.67±25235.24
After	5.53±0.95	4.49±0.24	127.5±5.82	40.78±2.47	0.38±0.03	121.7±50.77	5.61±0.68	21340.43±3085.67

Table 3. Various biochemical indicators of Athlete A before and after summer training.

	WBC	RBC	HGB	T	HCT	CK	BUN	C	T/C
Before	9.22	5.04	139.01	44.67	0.31	80.01	7.63	15540.31	0.00288
After	4.01	1.18	122.01	42.58	0.39	121.01	4.92	17836.21	0.00238

Table 4. Biochemical indicators of athletes before and after training B.

	WBC	RBC	HGB	T	HCT	CK	BUN	C	T/C
Before	5.41	4.29	122.01	38.64	0.38	284.01	6.92	19325.51	0.0021
After	6.21	4.68	134.01	38.19	0.42	183.01	6.58	21.918.81	0.0018

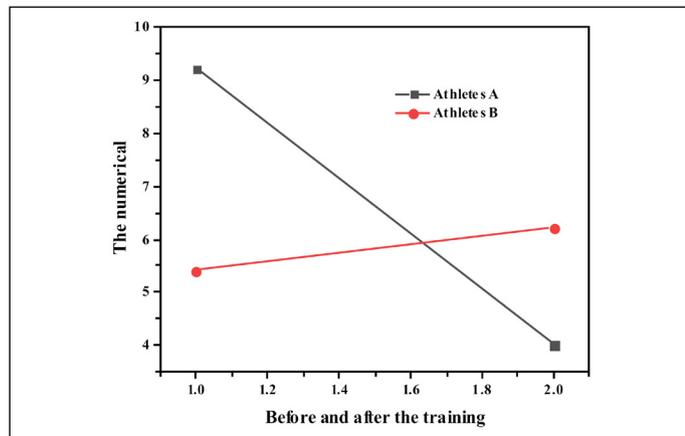


Figure 1. Comparison of white blood cell values before and after training A and B.

DISCUSSION

Athlete A's red blood cell value dropped from $5.03 \times 10^{12}/L$ to $4.19 \times 10^{12}/L$ after the summer training, the hemoglobin value dropped from $139.00g/L$ to $122.00g/L$, and the downward trend was obvious, the hematocrit value increased from 0.30 to 0.38, based on the analysis of these three indicators, A after summer training, the oxygen-carrying capacity of the body's blood decreases, and the body's function not only does not improve, but declines, it shows that the training intensity of summer training is not suitable for A, for A, the training intensity should be reduced, and the recovery and adjustment after training should be done well.⁸ Athlete B's red blood cell value increased from $4.28 \times 10^{12}/L$ to $4.69 \times 10^{12}/L$ after the summer training, the hemoglobin value increased from $122.00g/L$ to $134.00g/L$, and the hemoglobin value increased from 0.37 to 0.41, indicating that Athlete B's oxygen-carrying capacity improved after the summer training, compared with before the summer training, the physical function has been greatly improved.

After the normal decomposition of proteins and amino acids in the human body, urea nitrogen is produced, and urea nitrogen is often collected as an important reference index for athletes after sports training, it can accurately show how athletes are adapted to training intensity and how they perform.⁹ When athletes are exercising, the catabolism of protein in the body is accelerated, and the urea nitrogen produced will increase significantly, therefore, the determination of urea nitrogen value can reflect the functional state and recovery of athletes, and become an important reference index for scientific training. The urea nitrogen value

of athlete A decreased from $7.62mmol/L$ to $4.91mmol/L$, and the urea nitrogen value of athlete B decreased from $6.91mmol/L$ to $6.57mmol/L$, the urea nitrogen values of the two athletes showed a downward trend, indicating that the physical function and recovery of the two athletes were at a good level. Due to the longer recovery time of urea nitrogen value, therefore, test the indicator again on the next day, if the value change is not obvious, you can test again on the third day, if the value is stable and lower than the value before summer training, it means that the training load is suitable.¹⁰

Through case analysis, before the summer training, Athlete A's physical function level was at a high level, after the summer training, not only did not improve, but decreased, it means that the training volume during summer training is not suitable for B, and the training intensity should be moderately reduced, or it should be allowed to recover and adjust, athlete B, after training in summer training, physical function has been greatly improved. It shows that he has adapted to this training intensity, and in the future training, he can appropriately increase the training intensity to further improve his physical function level.

CONCLUSION

The author proposes a study on the confrontational analysis of athletes' scientific body functions in volleyball competitions, the author mainly adopts the experimental method, biochemical indicators were detected before and after summer training for five outstanding female volleyball players, and then individual players were analyzed on a case-by-case basis to increase the accuracy of the experiment. Athlete A's physical function status decreased significantly after summer training, while athlete B's physical function status improved slightly. It can be seen that reasonable and scientific monitoring of biochemical indicators is the purpose of evaluating athletes' training weeks, and is the determination of biochemical indicators in the summer training cycle of outstanding women's volleyball players, the purpose is to assess the physical function and evaluate the effect of sports training, and to understand the regularity of the function change of female athletes in the summer training cycle. In the process of evaluating the physical function of athletes, some indicators cannot be measured only once to draw conclusions, and some indicators need to be measured immediately after exercise, however, some indicators need to be measured for a certain period of time after exercise, and some indicators need to be measured continuously during the summer training cycle. Therefore, during the summer training period, it is necessary to carry out continuous index measurement on athletes to increase the timeliness of the data, which is conducive to the in-depth analysis of the athletes' physical state.

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