CORRELATION BETWEEN AEROBIC TRAINING AND PHYSICAL ENDURANCE IN BASKETBALL PLAYERS

CORRELAÇÃO ENTRE TREINAMENTO AERÓBICO E RESISTÊNCIA FÍSICA EM JOGADORES DE BASQUETE

CORRELACIÓN ENTRE ENTRENAMIENTO AERÓBICO Y RESISTENCIA FÍSICA EN JUGADORES DE BALONCESTO

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ABSTRACT

Introduction: Endurance is a quality that has been lacking in Chinese athletes. In most endurance sports training in China, there is a problem with attaching importance to high-intensity anaerobic training and ignoring aerobic training. The close combination of aerobic, strength and technical training is endurance training. A significant development trend in training. Objective: This study analyzes the relationship between aerobic training and physical endurance in basketball players. Methods: Basketball players were selected and randomly divided into groups through the analysis method with a questionnaire, observation method, and experimental method to analyze the relationship between aerobic exercise and physical endurance in basketball players. In this paper, the changes in physiological indicators of basketball players were recorded after aerobic exercise. Results: The physical endurance of basketball players were positively correlated with aerobic training time. The physiological indicators of basketball players and basketball skills after aerobic training were significantly improved (P<0.05). Conclusion: Aerobic exercise can improve basketball players' physical endurance and overall physical fitness, helping them achieve good results in competitions. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Physical Endurance; Exercise, Aerobic; Basketball; Athlete.

RESUMO

Introdução: Resistência é uma qualidade que tem faltado aos atletas chineses. Na maioria dos treinos esportivos de resistência na China, há um problema para atribuir importância ao treino anaeróbico de alta intensidade e ignorar o treinamento aeróbico. A combinação próxima de treinamento aeróbico e força e treinamento técnico é o treinamento de resistência. Uma tendência de desenvolvimento significativa na formação. Objetivo: Este estudo tem como objetivo analisar a relação entre treinamento aeróbico e resistência física em praticantes do basquete. Métodos: Jogadores de basquete foram selecionados e aleatoriamente divididos entre grupos passando pelo método de análise com questionário, método de observação e método experimental para analisar a relação entre exercício aeróbico e resistência física dos jogadores de basquete. Neste artigo, as alterações dos indicadores fisiológicos dos jogadores de basquete foram registradas após exercício aeróbico. Resultados: A resistência física dos jogadores de basquete foi positivamente correlacionada com o tempo de treinamento aeróbico. Os indicadores fisiológicos dos jogadores de basquete e as habilidades de basquete após o treinamento aeróbico foram significativamente melhorados (P<0,05). Conclusão: O exercício aeróbico não só pode melhorar a resistência física dos jogadores de basquete como também sua aptidão física geral, ajudando-os a alcançarem bons resultados nas competições. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Resistência Física; Exercício Aeróbico; Basquetebol; Atleta.*

RESUMEN

Introducción: La resistencia es una cualidad de la que carecen los atletas chinos. En la mayoría de los entrenamientos de deportes de resistencia en China, existe el problema de dar importancia al entrenamiento anaeróbico de alta intensidad e ignorar el entrenamiento aeróbico. La estrecha combinación del entrenamiento aeróbico y el entrenamiento de fuerza y técnico es el entrenamiento de resistencia. Una tendencia de desarrollo importante en la formación. Objetivo: Este estudio pretende analizar la relación entre el entrenamiento aeróbico y la resistencia física en jugadores de baloncesto. Métodos: Se seleccionaron jugadores de baloncesto y se dividieron aleatoriamente entre grupos pasando por el método de análisis con cuestionario, método de observación y método experimental para analizar la relación entre el ejercicio aeróbico y la resistencia física en jugadores de baloncesto. En este trabajo se registraron los cambios de los indicadores fisiológicos de los jugadores de baloncesto después del ejercicio aeróbico. Resultados: La resistencia física de los jugadores de baloncesto se correlacionó positivamente con el tiempo de entrenamiento aeróbico. Los indicadores fisiológicos de los jugadores de baloncesto y las habilidades de baloncesto después del entrenamiento aeróbico mejoraron significativamente (P<0,05). Conclusión: El ejercicio aeróbico no sólo puede mejorar la resistencia física de los jugadores de baloncesto, sino también su estado físico general, ayudándoles a conseguir buenos resultados en las competiciones. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Resistencia Física; Ejercicio Aeróbico; Baloncesto; Atleta.*

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INTRODUCTION

Basketball is a sport that requires a close combination of endurance, speed, strength, flexibility, agility, reaction, psychology, and other qualities and techniques. If players want to improve basketball, they must have a comprehensive training program that includes the above requirements. Superficial and biased training programs are impossible to achieve this goal. After years of experimental observation in academia, it has been found that better endurance is the fundamental guarantee for winning the game.[1] Low stamina is the main reason for the failure of the vast majority of players. Correctly looking at and solving the endurance in basketball is related to whether the level of modern basketball can be further improved. We did some preliminary research on this and got some conclusions.

Endurance is built through aerobic training. Speed is gained from anaerobic training. Strength builds with weight training. Special specialized training improves flexibility, agility, reflexes, psychology, and special skills. This is considered the best training method for any sport. Therefore, any sports training must go through the above aspects: (1) Athletes conduct aerobic training to improve working endurance. (2) Athletes train on anaerobic energy supply capacity to speed up movement speed and displacement speed. (3) Athletes enhance muscle strength to achieve strength training. (4) Athletes usually need to increase the range of motion of the joints. (5) Athletes need to carry out special training in various specialties to promote the development of sensitivity, reaction, coordination, psychology, and technology. Aerobic endurance is often overlooked due to insufficient training time in athletes.

METHOD

Experimental subjects

In 5 years, we distributed 430 questionnaires in 7 competitions at or above the municipal level. Four hundred twenty questionnaires were returned. There were 420 valid questionnaires. The questionnaire asked players to answer the following questions: What do you think are the main reasons for the game's failure? The options for the questionnaire include physical exhaustion, injury, poor skill, and lack of competition experience.[2] Finally, there are the following statistical results Table 1. The above results can be regarded as the subjective feeling of athletes. From an objective observation point of view, the investigators judged and recorded each player at the game site. The results were consistent with the subjective feeling of the sport.

Table 1. Statistical result table of failure reasons.

Weakness	Injury	less-skilled	Inexperienced in the game
75%	5%	10%	10%

Research methods

This paper uses the wireless sensor network to realize the image information collection of basketball training posture.[3] We marked the collected basketball training pose images with grey outlines. In this way, the visual 3D information fusion of basketball training pose images is obtained:

$$\begin{cases} X(G_n)=\sqrt{a_1+a_2+a_3}+\dfrac{\Phi(T_n)}{\gamma_i} \\ Y(G_n)=\sqrt{b_1+b_2+b_3}+\dfrac{\Phi(T_n)}{\theta_i} \\ Z(G_n)=\sqrt{c_1+c_2+c_3}+\dfrac{\Phi(T_n)}{\omega_i} \end{cases} \quad (1)$$

X, Y, Z represents the X, Y, Z axis, respectively. $X(G_n), Y(G_n), Z(G_n)$ respectively represent the information fusion results of the X, Y, Z axis. $a_n(n=1,2,3,K,n)$, $b_n(n=1,2,3,K,n)$, $c_n(n=1,2,3,K,n)$ represent the translation parameters of the basketball training pose image on the X, Y, Z axis, respectively. γ_i, θ_i, ω_i, respectively, represent the gray outline markers of the basketball training pose images on the X, Y, Z axis. $\Phi(T_n)$ represents the image feature value of basketball training pose:

$$\Phi(T_n)=\sum_{i=1}\sqrt{\gamma_i+\theta_i+\omega_i} \quad (2)$$

We combine the two-dimensional distributed fusion of datasets to obtain the sampling point matrix (H) of basketball training posture information. We combine the method of symmetric matrix fusion tracking and recognition to obtain the pixel distribution matrix element (h_{ij}) of the basketball training pose image.[4] Under the three-dimensional visual tracking recognition model, we construct a fuzzy parameter recognition model of basketball training pose motion images. Assume that the cluster center grid parameter distributions for motion-imaging are a, b, c and γ, θ and ω. We adopt the method of edge feature point information fusion scheduling and at the same time, use the statistical feature quantity of edge contour detection points to obtain the linear equations of basketball training posture intelligent monitoring visual imaging:

$$\begin{cases} x_o=(a+\gamma\cdot a)^2+\sqrt{X(G_n)} \\ y_o=(b+\theta\cdot b)^2+\sqrt{Y(G_n)} \\ z_o=(b+\omega\cdot b)^2+\sqrt{Z(G_n)} \end{cases} \quad (3)$$

We reconstruct abnormal feature points in the gray-scale pixel region of surveillance video images.[5] At the same time, this paper performs cluster analysis on the data set of abnormal feature points of the entire image to obtain a basketball training posture intelligent monitoring visual imaging model:

$$g(x,y)=\| x_o+y_o+z_o \|-\sum_{x,y\neq 0} f(x,y)+\frac{\varepsilon(x,y)}{2} \quad (4)$$

$g(x,y)$ represents the basketball training posture intelligent monitoring visual imaging model. $f(x,y)$ represents the gray level of the image. $\varepsilon(x,y)$ represents the guided filter function of intelligent monitoring images of basketball training poses. We completed the effective recognition of basketball training poses based on the imaging results of intelligent monitoring.

We build a basketball training posture visual image fusion model based on the intelligent monitoring visual imaging model of basketball training posture. In this way, the edge pixel set P is obtained as formula (5).

$$P=\sqrt{g(x,y)+P_n} \quad (5)$$

P_n represents the sampling point of the initial wireless sensor network. In the LAN environment, we establish a fuzzy edge pixel distribution set for intelligent monitoring of basketball training postures.[6] This paper obtains the statistical template function of 2 × 2 pixels in the visual 3D information tracking template. We adopt the method of pixel point difference feature matching to obtain the abnormal action feature point of intelligent monitoring of basketball training posture as x_{ij}', y_{ij}. At this point, we find outlier feature points in the boundary mesh object. At this time, we get the mean square error e as formula (6).

$$e = \int_0^{\infty} f(x_{ij}')dx + \frac{f(y_{ij}')}{N-n} \quad (6)$$

N is the total number of sensor nodes in the distribution grid for basketball training pose images. n is the visual feature point of fuzzy 3D segmentation. We obtain the image feature detection component of basketball training pose as $\|\varphi\| = \sup |\varphi(\theta)$ according to the boundary grid between clusters.[7] We obtain the pixel difference ERR point feature of intelligent monitoring of basketball training postures based on all spatial grid pixels:

$$ERR = \sqrt{n \times N}\left[\frac{f(x_{ij}') - \|\varphi\|}{\|\varphi\| - f(y_{ij}')}\right]^2 \quad (7)$$

RESULTS

Comparison of men's 1500m and women's 800m running results with basketball results

Exercise physiology studies have shown that running 800-1500 meters is a speed endurance event.[8] The results can better reflect intolerance and anaerobic metabolism. We surveyed the men's 1500m and women's 800m performances of the top 6 players in the last three competitions. According to the characteristics of basketball, we divided the 1st, 2nd, 3rd, 4th, 5th, and 6th with similar physical and psychological qualities, game experience, and technical level into three groups. We compare them with average grades. (Table 2)

Comparison of 12-minute running performance and basketball performance

The 12-minute run is commonly used at home and abroad to test aerobic endurance and aerobic metabolic capacity. We take a 12-minute run test on the top six players in a basketball game. The study found that 80% of men's 1 and 2 were over 3000 meters. 3.4 95% of the results in 2800 ~ 2950 meters. 90% of the 5.6th in the 2600 ~ 2730 meters. 85% of the women's 1st and 2nd places are above 2750 meters. 3. 90% of the 4th place in the 2500-2700 meters. 95% of the 5th and 6th place in the 2280 ~ 2400 meters. The survey test results fully demonstrate the high correlation between endurance and basketball performance.[9] The better the endurance performance in basketball, the higher the basketball ranking.

DISCUSSION

Basketball is a high-intensity, high-confrontation sport. This determines that its energy supply method should be mainly anaerobic. Therefore, coaches should vigorously develop anaerobic endurance.[10] Aerobic training often adopts two methods: continuous exercise and intermittent exercise. Intermittent training includes interval training and repetition training. According to basketball and the game characteristics, we found that the best method should be interval training. The endurance development must also follow the "progressive limit load" principle. When the level of training increases, the physical load must also increase. This will allow you to gain more stamina. The load can be adjusted in the following four ways: (1) Increase the number of repetitions. (2) Increase the time of each repetition. (3) Increase the intensity of each repetition. (4) Shorten the interval time. The coach must choose the appropriate training intensity when using the above methods. The intensity of work and the time it can last are mutually restrictive. Low-intensity work can last for a long time, but it cannot fully mobilize the body's breathing-circulation function. On the contrary, the duration is shortened when the intensity is too high. Energy supply characteristics may change at this time, and there is no evidence that anaerobic processes contribute to the development of aerobic endurance. So how to choose a moderate training intensity is very important. Heart rate can be used to indicate a suitable training load. The specific interval training methods are as follows: The number of training sessions is 3 to 5 times a week. The training intensity is to maintain the heart rate within ten times above and below the maximum heart rate. Practice time is 3 to 5 minutes each time. The intermittent time is 3 to 5 minutes or less than 3 to 5 minutes.

It is pretty tricky for basketball players to continue the practice of higher-difficulty movements for 3 to 5 minutes. This can be achieved using other forms of aerobic work training. Such as "slow interval running" is a better way to develop aerobic endurance. When doing basketball cardio training, try to avoid demanding a higher level of training from the start. Rushing for success can lead to excessive fatigue and muscle pain.[11] This can lead to the failure of single and combined technical actions. Even the situation affects the implementation of the entire training program. Ideal results should generally be obtained after six weeks of training. The burden of aerobic training was measured by the number of pulses 5 minutes after the training session. Generally, the pulse should not exceed 120 beats after 5 minutes and should not exceed 100 beats after 10 minutes.

Basketball training must also include various other physical and technical exercises. It is necessary and practical to focus on specific aspects of training within a certain period. Athletes must pay attention to the connection of each training link when carrying out the following training goal. If it is out of touch, the achievements made by each link will fade or even be lost. Therefore, aerobic training must be persistent and persistent.

Table 2. Statistics of the average performance of the top 6 players in the men's 1500m and women's 800m running.

Index	Men's 1500m			Women's 800m		
N	30	24	20	30	22	17
Ranking	1,2	3,4	5,6	1,2	3,4	5,6
Mean	4:50.0	5:03.0	5:33.0	2:50.0	3:10.0	3:34.0

CONCLUSION

Endurance in basketball cannot be ignored. Aerobic training for basketball players should be strengthened because it helps to improve the level of particular sports and enables athletes to maintain a good competitive state during the competition. This is conducive to the development of technology and also reduces or avoids the occurrence of sports injuries.

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REFERENCES

1. Do Prado DML, Silvino VO, Motta-Santos D, Dos Santos MAP. The effect of the protective face mask on cardiorespiratory response during aerobic exercise. Clin Exp Pharmacol Physiol. 2022;49(4):453-61.
2. Malta ES, Dutra YM, Broatch JR, Bishop DJ, Zagatto AM. The effects of regular cold-water immersion use on training-induced changes in strength and endurance performance: a systematic review with meta-analysis. Sports Med. 2021;51(1):161-74.
3. Tryfidou DV, McClean C, Nikolaidis MG, Davison GW. DNA damage following acute aerobic exercise: a systematic review and meta-analysis. Sports Med. 2020;50(1):103-27.
4. Catapani LB, Dos Santos TP, Toffano GC, Souza HCD, de Araujo JE. Aerobic Exercise After Left-Sided Stroke Improves Gait Speed and Endurance: A Prospective Cohort Study. Am J Phys Med Rehabil. 2021;100(6):576-83.
5. Hwang PS, Machek SB, Cardaci TD, Wilburn DT, Kim CS, Suezaki ES, et al. S. Effects of pyrroloquinoline quinone (PQQ) supplementation on aerobic exercise performance and indices of mitochondrial biogenesis in untrained men. J Am Coll Nutr. 2020;39(6):547-56.
6. Duke JW, Lovering AT. Respiratory and cardiopulmonary limitations to aerobic exercise capacity in adults born preterm. J Appl Physiol. 2020;129(4):718-24.
7. Philp AM, Saner NJ, Lazarou M, Ganley IG, Philp A. The influence of aerobic exercise on mitochondrial quality control in skeletal muscle. J Physiol. 2021;599(14):3463-76.
8. Yakasai AM, Maharaj SS, Nuhu JM, Danazumi MS. Moderate intensity endurance exercise: a beneficial intervention for relative cardiovascular parameters of primary and secondary hypertensive patients. Randomised controlled trial. Eur J Physiother. 2021;23(4):259-65.
9. Bao C, Yang Z, Li Q, Cai Q, Li H, Shu B. Aerobic endurance exercise ameliorates renal vascular sclerosis in aged mice by regulating PI3K/AKT/mTOR signaling pathway. DNA Cell Biol. 2020;39(2):310-20.
10. Antunes BM, Rossi FE, Oyama LM, Rosa-Neto JC, Lira FS. Exercise intensity and physical fitness modulate lipoproteins profile during acute aerobic exercise session. Sci Rep. 2020;10(1):1-8.
11. Zhu Q, Chen C, Zhu G. Aerobic exercise exercise prescription design and calculation. J Hum Mov Stud. 2022;3(1):1-8.