

Research on Weekly Load Characteristics and Physical Effect of Physical Education Training Based on Data Mining Technology

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Abstract

in Sports Training, the Training Load is the Most Important Factor That Affects the Sports Performance. Reasonable Arrangement of Training Means, Load Amount and Load Intensity Before the Competition is the Key and Basic Factor to Cause Athletes' Body Function Changes, Obtain Good Training Effect and Improve Sports Performance. in This Study, Based on Data Mining Technology, Using the Methods of Literature Review, Questionnaire Survey and Mathematical Statistics, the Weekly Load Characteristics and Physical Effects of Physical Education and Training Are Comprehensively Studied, Aiming At Sorting out and Analyzing the Characteristics and Laws of Players' Annual Periodic Physical Training Load, and Providing Theoretical and Quantitative Indicators for the Formulation and Implementation of the Annual Periodic Physical Training Load of Basketball Teams in China in the Future. the Results Show That Using Data Mining Technology to Analyze the Application of Athletes' Healthy Sports Behavior Makes Sports Related Data Mining More Accurate and Statistical Analysis More Reliable.

Keywords: *Data mining, Weekly load, Physical fitness, Heart rate*

I . Introduction

Athletes' sports load refers to the stimulation of effective training by taking physical exercises as the basic means. The main response of this stimulus is manifested in both physiological and psychological aspects. Sports load is mainly composed of two factors: load quantity and load intensity, which are interrelated and influence each other. Different load structures are formed through different collocation and combination between them [1]. In the case of excessive fatigue, it will deform the athletes' unformed movements, which is very unfavorable to the training effect and the improvement of technical movements. Therefore, only by mastering the appropriate amount of exercise and intensity can the quality of athletes' movements be guaranteed [2-3]. At present, most coaches can only monitor the heart rate of a certain training amount and intensity, but do not fully grasp the heart rate change law of load amount and intensity in the annual, periodic and weekly planning stages, which leads to the heart rate monitoring not being closely related to the actual training [4].

Today, with the development of big data information technology, sports training management is statistically analyzed with big data, combined with the statistical results of the big database of basketball players' healthy sports training, athletes' healthy sports behavior is predicted and evaluated, relevant policy decisions are accurately made, and sports management level is improved. Therefore, this paper will use data mining technology to make a systematic and comprehensive study on the weekly load characteristics and physical effects of physical education and training. The purpose is to provide theoretical reference and practical guidance for Chinese basketball players to make training plans scientifically and reasonably and to evaluate the training load in real time.

II . Research Objects and Methods

A. Research Objects

In this study, the annual training plan of a basketball team is taken as the research object, and 10 coaches of a training base are taken as the interview investigation object.

B. Research Method

1) Data Mining

Data mining of athletes' healthy sports behavior is carried out under the big data environment, and a big data information resource network database of athletes' healthy sports behavior is constructed. The edge sequence of the tree structure of athletes' healthy sports behavior resource database is $\{e_1, e_2, \dots, e_r\}$, in which $e_i = (o_i, p_{i+1})$, $1 \leq i \leq r$, $o_i \in \{p_1, p_2, \dots, p_i\}$, the seasonal influencing factors of athletes' physical exercise satisfy:

$$\text{dist}(e_i) = \text{dist}(o_i, p_{i+1}) = \text{dist}(\{p_1, p_2, \dots, p_i\}, p_{i+1}) \quad (1)$$

At this time, $\{\text{dist}(e_1), \text{dist}(e_2), \dots, \text{dist}(e_r)\}$ is called the health benefit index of athletes' healthy sports behavior.

In the information storage model of health sports behavior benefit index, the parameter system of health benefit index is fitted by constructing the feature data entity set, and the big data information fitting model is described as:

$$R_\beta X = U \{E \in U / R | c(E, X) \leq \beta\} \quad (2)$$

$$R_\beta X_1 = U \{E \in U / R | c(E, X_1) \leq 1 - \beta\} \quad (3)$$

$$\text{bnr}_\beta(X) = R_\beta X - R_\beta X_1 \quad (4)$$

The characteristic data of athletes' healthy sports behavior is influenced by fitness equipment, seasons, school physical education courses and other factors, so it is necessary to mine and analyze these information data [5], and get the static and dynamic query template set of the characteristic data mining of athletes' physical exercise.

Using particle swarm optimization support vector machine to mine sports behavior big data information [6-7], the flight process of particle swarm optimization is as follows:

$$\begin{cases} v_t = wv_{t-1} + c_1 \text{rand}_1(\cdot) \cdot (p_{\text{best}} - x_{t-1}) + c_2 \text{rand}_2(\cdot) \cdot (g_{\text{best}} - x_{t-1}) \\ x_t = x_{t-1} + v_t \end{cases} \quad (5)$$

In which: v_t is the speed at which particles run; x_t is the fitness value of particles; c_1 and c_2 are optimal learning operators; $\text{rand}_1(\cdot)$ and $\text{rand}_2(\cdot)$ are random numbers between [0,1].

The feature data mining process of athletes' healthy sports behavior is as follows:

$$\begin{aligned} \min(w, \xi, \xi^*) &= \dot{X} \frac{1}{2} \|w\|^2 + \dot{Y} C \sum_{i=1}^n (\xi_i, \xi_i^*) \\ \text{s.t. } H_i(z) &\begin{cases} y_i w^T \Phi(x) - b \leq \varepsilon + \xi_i^* \\ -y_i + w^T \Phi(x) + b \leq \varepsilon + \xi_i \\ \xi_i^*, \xi_i \geq 0 \end{cases} \quad (6) \end{aligned}$$

In which: $\dot{X}$ is the update balance factor of particle algorithm; $\dot{Y}$ is the load of data mining; $H_i(z)$ is the fuzzy decision system function of athletes' healthy sports behavior characteristic data distribution.

2) Literature Investigation Method

According to the needs of the research, through the library, database, internet and other media of the Institute of Physical Education, the related literatures about basketball training program, training plan, basketball training cycle load arrangement, basketball physical training and so on were consulted, and sorted, classified, summarized and refined to provide theoretical support for this study.

3) Questionnaire Survey Method

According to the needs of this paper, the coach questionnaire is designed. A questionnaire survey was conducted among 10 basketball coaches, 5 excellent athletes and 3 related sports training experts and scholars to provide data support for the research of this paper. The questionnaire has been tested for validity and reliability. A total of 30 questionnaires were distributed and 30 questionnaires were recovered, with a recovery rate of 100%; 30 valid questionnaires were collected and the effective rate was 100%.

4) Mathematical Statistics

For the valid data collected from the test, the analysis software of heart rate meter is used to analyze the obtained data. According to the mathematical statistics method and sports statistics principle, Excel and SPSS statistical software are used to count and process the data.

III. Research Results and Analysis

A. Theoretical Analysis of Key Factors Affecting Basketball Players' Physical Fitness

Athletes' physical fitness refers to the basic athletic ability of athletes and is the main component of athletes' competitive ability. The development of body shape, physical function and sports quality constitute the physical fitness of athletes, and the evaluation of athletes' functional state is mainly realized by a series of physiological and biochemical indicators.

According to research, the best competitive mode of excellent basketball players one week before the competition is: male hemoglobin is not lower than 1419/L, serum creatine kinase is not higher than 216U/L, and blood urea is not higher than 6.1 mmol/L; Women's hemoglobin is not lower than 1269/L, serum creatine kinase is not higher than 118U/L, and blood urea is not higher than 5.4 mmol/L [9].

Technology is the way to complete sports actions, and the formation of basketball skills and tactics is a long-term process. The formulation of training plan must not only consider the adaptability and periodicity of the body, but also conform to the formation law of skills and tactics. Skilled skills, rich competition experience and good competitive state are the basic conditions for basketball players to achieve excellent results. In the large-scale competition, the contestants' technical level is quite close, and the competition is fierce. The result of the competition depends not only on the training level, but also on the competitive state and on-the-spot performance. At present, the competition of high-level athletes is extremely fierce, new technical movements are constantly emerging, and sports achievements are greatly improved, all of which cannot be separated from scientific physical training. Physical training has become the key to make breakthroughs in sports skills and sports achievements, and it is the most favorable guarantee to improve sports skills and sports achievements [10].

Competition is the core and essence of basketball competition, and it is the comprehensive competition of athletes' body, technique, tactics and psychology. In basketball competition, because of the uncontrollable external natural conditions and the fierce competition, it is very important to use tactics to confront opponents under the restriction of rules. Basketball requires athletes to have good attention quality. Because of the openness of the competition environment and the instantaneity of changes in external conditions, athletes must be sensitive to external changes, observe their opponents' positions in time, and predict possible threats to themselves. Therefore, athletes must have

good attention span, attention distribution and attention transfer.

B. Investigation Results of Physical Fitness Characteristics of Basketball Teams in Different Stages of the Annual Cycle

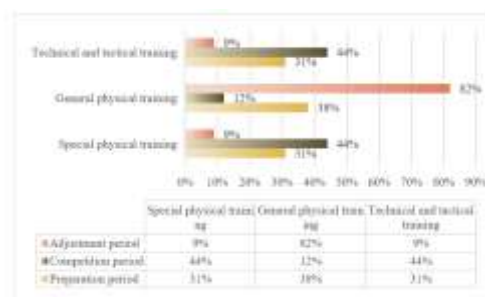


Fig.1 Distribution of Physical Fitness Characteristics in Different Stages of Basketball Annual Cycle

It can be seen from Figure 1 that the arrangement of the amount of exercise in basketball team training in different periods is changeable. The training in preparation period mainly focuses on general physical training, accounting for 38%, followed by special training and technical and tactical training, accounting for 31% each. During the competition period, special physical training and technical and tactical training are the main ones, each accounting for 44%, while general physical training only accounts for 12%. The training in adjustment period is mainly general physical training, accounting for 82%, while special physical training and technical and tactical training only account for 9%. According to the distribution chart of exercise quantity in three periods, in physical training of basketball team, physical training in preparation period mainly develops athletes' general physical fitness, physical training in competition period focuses on developing athletes' special physical fitness, and physical training in recovery period pays more attention to developing athletes' general physical fitness.

C. Load Dynamics of Small Cycle Training Plan Before Competition

Fig.2 Shows the Change of Training Plan Load.

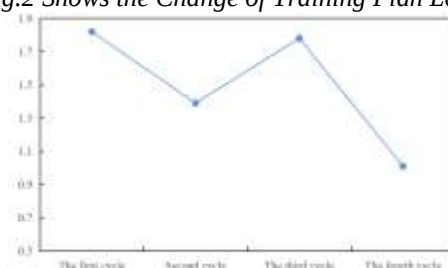


Fig.2 Training Plan Load Change

From Figure 1, we can see that the training plan load of basketball players in the first cycle is 1.82km, which gradually decreases with the passage of time. When the training plan load reaches the second cycle, it drops to 1.39km due to physiological reasons. From the second cycle to the third cycle, the load of the training plan gradually increased, reaching 1.78km in the third cycle, but the load of the training plan was still lower than that of the first cycle.

From the third cycle to the fourth cycle, the planned load of process training began to decrease gradually, and it was lower than that of the second cycle. When the fourth cycle arrived, the planned load was only 1.01km.

In training, four cycles are one cycle. In the fourth cycle, because of the approach of the game, in order to make basketball players recover properly after a large amount of exercise, the load of training plan reaches the lowest level, which makes them better adapt to the rhythm of the game, and also makes them enter the training of the next cycle more smoothly and adapt to the high-intensity training of the next cycle after the game.

D. Analysis of Heart Rate in Physical Training Class during Pre-Competition Training Week

The main feature of physical training class arrangement is to develop athletes' general and special sports qualities and improve and maintain their physical level by arranging various training means and methods. In most cases, the load of physical training class is heavy, and the main function of physical training class is to improve and consolidate athletes' physical level. Therefore, it is an important link to arrange the sequence and load of different quality training. More than two kinds of sports quality training are often arranged in a training class. Generally speaking, the fast strength training should be arranged in the first half of the training class to ensure the training quality and achieve ideal results. When athletes feel tired, they should arrange some endurance quality or strength endurance quality exercises.

The grasp of load measurement and the arrangement of training rhythm have an important influence on the effect of training courses. With the improvement of physical training level, the training load is gradually increased, so as to stimulate the athletes' body more deeply and cause obvious adaptability changes of athletes' physical fitness. However, during training, it must be noted that the greater the training load, the better. It is most important to grasp the "degree" of training load and arrange the rhythm of training load in different classes.

Uniform speed continuous training is a typical training method aiming at the energy supply capacity of aerobic metabolism system, which is characterized by relatively low exercise intensity, small change of load intensity and relatively uniform exercise speed. The exercise process is uninterrupted, and the exercise load is generally about 160 beats per minute, which consumes less energy.

Characteristics of developmental interval training: the training time is more than 5 minutes, the average heart rate is about 160 beats / min, and the heart rate drops to 122 beats / min for the next training. In the continuous running and sprint of this training course, the average maximum heart rate of the team members is 167.5 ± 7.33 beats / min, and the average heart rate is 132.3 ± 6.51 beats / min (see Figure 3 and table 1).

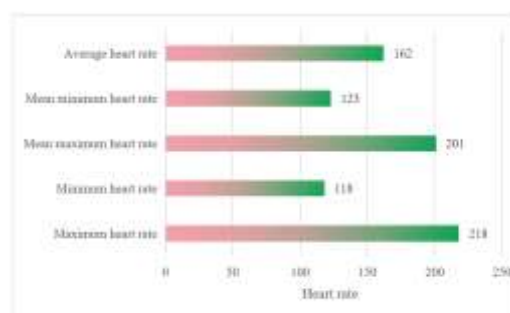


Fig.3 Heart Rate Statistics

Table 1 Heart Rate In Physical Training Class

Projects	Maximum heart rate	Minimum heart rate	Average maximum heart rate	Mean minimum heart rate	Average heart rate
Standard deviation	187	83	167.5 ± 7.33	97.22 ± 17.93	132.3 ± 6.51

The overall heart rate training intensity of physical training class before the competition week is lower than the load intensity requirement, which may be mainly due to two reasons, one is related to the subjective efforts of the players, and the other is that the training intensity is already large enough. With the improvement of training level, the highest heart rate will decrease in training, and the heart rate index will not reflect very high.

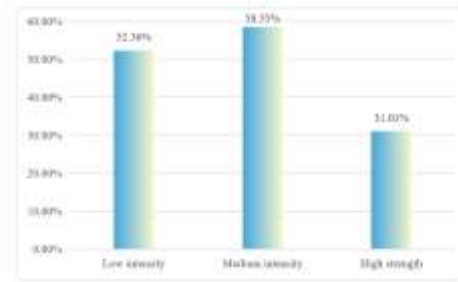


Fig.4 Heart Rate Interval in Physical Training Class

Table 2 Heart Rate Interval in Physical Training Class

Projects	Low-intensity	Medium strength	High-intensity
Standard deviation	0.4±0.06	0.5±0.08	0.2±0.04

Heart rate zone time refers to the proportion of different intensity training time to the total time in a training course, which is one of the indicators reflecting the intensity of training. The results show that the low intensity is 0.4 ± 0.06 , the medium intensity is 0.5 ± 0.08 , and the high intensity is only 0.2 ± 0.04 . In the pre-competition training week, the physical training classes are mainly medium-intensity and low-intensity, and the training intensity is not high, which may be related to insufficient subjective efforts of athletes, high training level of athletes and low training intensity. The exact reasons need further investigation and discussion (see Figure 3 and Table 2).

E. Analysis of Prediction Results of Sports Behavior Data Mining

Analyze and sample the big data of athletes' healthy sports behavior characteristics database, analyze the statistical characteristics of athletes' healthy sports behavior, and first determine the decision variables: the influencing factors of sports season are selected, and the corresponding variables are defined as $Z_i (i=1,2,\dots,10)$; The educational importance of athletes' healthy sports behavior is defined as $W_{ki} (i=1,2,\dots,7; k=1,2,\dots,7)$; The social input of athletes' healthy sports behavior is defined as $X_{ij} (i=1,2,\dots,7; j=1,2,\dots,10)$; The inertia weight is 0.79, the correlation coefficient $R = 0.5306$, and the mean square error $MSE=0.0301$.

Taking athletes' healthy sports behavior data samples as test data sets, data mining and behavior prediction are carried out, and the results of feature distribution and prediction distribution of the original data are shown in Figure 5.

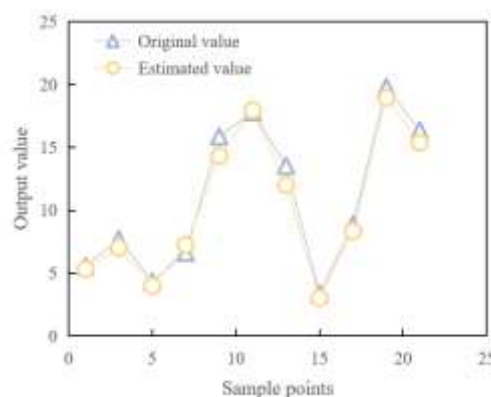


Fig.5 Prediction Results of Sports Behavior Data Mining

It can be seen from fig. 5 that through the prediction of athletes' healthy sports behavior data, the convergence of

data feature distribution is better and the disturbance error is lower.

IV. Conclusion and Suggestion

A. Conclusion

(1) Basketball team training in different periods of physical training, the distribution of exercise has its distinct stage characteristics. Preparatory training is mainly based on general physical training, supplemented by special training and technical and tactical training; The training during the competition period is mainly based on special physical training and technical and tactical training, supplemented by general physical training; The training in the adjustment period is mainly based on general physical training, supplemented by special physical training and technical and tactical training.

(2) The changes of heart rate of basketball players in pre-competition weekly training class basically conform to the characteristics of weekly training and football training rules, and basically complete the goals and tasks of pre-competition weekly training plan.

(3) Physical training of basketball players is one of the most important factors affecting sports performance. Six factors, such as physical fitness, sports skills, psychological characteristics, tactical accomplishment, load bearing ability, special intelligence and recovery ability, are all important factors that affect the performance of basketball players in the process of physical training.

(4) Using data mining technology to analyze the application of athletes' healthy sports behavior, the accuracy of sports related data mining is high, which can effectively guide athletes' sports management and training.

B. Suggestion

(1) After each practice class in the pre-competition training week, we don't pay enough attention to physical relaxation practice, so we should strengthen physical relaxation after training.

(2) Technical and tactical training courses are relatively simple in training methods, which can not improve athletes' training enthusiasm. Therefore, appropriate methods and means of training hands should be selected according to the physical and mental characteristics of basketball players, so that they can actively participate in training.

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