

Effect of Nutrition Method on Physical Recovery and Improvement of Basketball Player Based on Fuzzy Clustering Algorithm

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Abstract

Basketball belongs to the antagonism project, therefore it is necessary to apply effective nutrition methods to improve physical recovery and improvement of basketball player, the fuzzy clustering algorithm is applied in it. Firstly, the fuzzy clustering algorithm combining with Monte Carlo T inspection is studied. Secondly, the main affecting factors of physical ability of basketball player are discussed. Thirdly, the corresponding experiment is carried out, and results show that the fuzzy clustering algorithm can be applied in analyzing the effect of nutrition method on physical recovery and improvement of basketball player.

Keywords: *physical ability; basketball player; nutrition method; fuzzy clustering algorithm*

1. Introduction

Basketball belongs to the antagonism project with competition in the same field, which is skill class sport. The basketball sports time is a long period. The waiting time of basketball player is short and frequent. The strength and quantity of basketball sport are big, and the energy supply characteristics of it conclude aerobic and anaerobic activity. Therefore ATP-CP and glycolysis play an important role. The blood lactate of basketball player is about 8.4mmol/L after high load movement, and reaches 11mmol/L four minutes later after movement. When the basketball player carries out continuous rush and regional press tactics, the player gives first place to anaerobic energy supply. For the basketball player with good physical ability, ATP-CP energy supply system in a time of 20-30 min only recovers about half. And the complete recovery needs 2-5 min. The glycogen lactic acid energy supply system restores half, and the whole recovery time is an hour or longer time. Therefore, glycogen lactic acid energy supply system can not be recovered completely even through about 15 min rest time in midfielder, and can recover completely after longer time. The consumption of energy substance and accumulation of lactic acid in muscle and blood are main reasons of generating fatigue of basketball player [1].

In order to improve the physical ability of basketball player, the effective nutrition method should be applied in it. The competition in high altitude has the following antagonism, which can propose higher requirement for the strength, speed, endurance, and sensitivity of basketball player. Therefore the basketball player should have good nutrition measurement, the nutrition should be complete. The proportion of three energy substances should be fit for the energy characteristic of basketball player, the proper proportion of sugar, protein and fat in food to total energy are 60-70%, 12-15%, and 20-30% respectively. What's more the sugar is rich and digestible, the protein with high quality should be chosen, where the animal protein should occupy about 60%, which can promote the muscle growth and tissue repair. Eating more vegetables and fruits can buffer the effect of metabolites. In addition the proper B vitamin, vitamin C and Calcium, phosphorus, iron, electrolytes and water should be supplied. Adding nutrient substance

enhancing immune function properly can improve disease resistance of human body [2]. In order to improve the effectiveness of analyzing the effect of nutrition method on physical recovery and improvement of basketball player, the fuzzy clustering algorithm is applied.

2. Basic Procedure of Fuzzy Clustering Algorithm

(1) Basic of fuzzy clustering algorithm

The fuzzy C average value clustering algorithm is used in this research, which is a kind of fuzzy clustering algorithm, although the variables are difficult to be classified obviously, the fuzzy C average value clustering can obtain good effect. A sample collection $X = [x_{ij}]$ is given, where $i = 1, 2, \dots, n$; $j = 1, 2, \dots, m$. n denotes the number of samples, m denotes the number of variables in every sample, and this collection is defined by [3]

$$X = \{x_1, x_2, \dots, x_j, \dots, x_n\} \quad (1)$$

where $x_j = \{x_{j1}, \dots, x_{jm}\}$.

The collection in formula (1) can be divided into c fuzzy sub sets based on fuzzy clustering method and a certain principle, where c denotes the pre-given number of clustering. The fuzzy clustering results can be expressed by membership degree matrix $U = [u_{ij}]$, $0 < u_{ij} < 1$, and u_{ij} satisfies the following conditions:

$$\sum_{i=1}^n u_{ij} = 1 \quad (2)$$

$$0 < \sum_{j=1}^m u_{ij} < n, \quad i = 1, 2, \dots, c \quad (3)$$

And the objective function of fuzzy C average value clustering algorithm is listed as follows [4]:

$$J(u_{ij}, v_j) = \sum_{i=1}^c \sum_{j=1}^m u_{ij}^w \|x_j - v_j\|^2, \quad w > 1 \quad (4)$$

where w denotes the index weight of fuzzy degree affecting the membership degree matrix.

The algorithm procedure of confirming the membership degree is listed as follows [5]:

Step 1: the number of friendly number c is used as classification number, and the error is defined by E_{\max} .

Step 2: the ant colony algorithm is used to get the original clustering center $O_i(t)$, $i = 1, 2, \dots, c$.

Step 3: the membership degree is calculated.

Step 4: all clustering centers are amended.

Step 5: the error is calculated, which is expressed as follows:

$$e = \sum_{i=1}^c \|O_i(t+1) - O_i(t)\|^2 \quad (5)$$

When $e < E_{\max}$, the algorithm is over, otherwise $t = t + 1$, and return to step (3).

In order to avoid the sensitivity of the fuzzy clustering algorithm to initial value, and prevent the problem of falling into local optimum, the priori knowledge can be used to choose the proper original value, therefore the improved particle swarm is used to choose the optimal initial value. The particle swarm algorithm is constructed by Kennedy and Eberhart in 1995, which has been applied in engineering problem, it has many advantages,

for example, this algorithm is easy to be achieved, and the controlling parameters can be regulated easily. The procedure of particle swarm algorithm is shown in Figure 1.

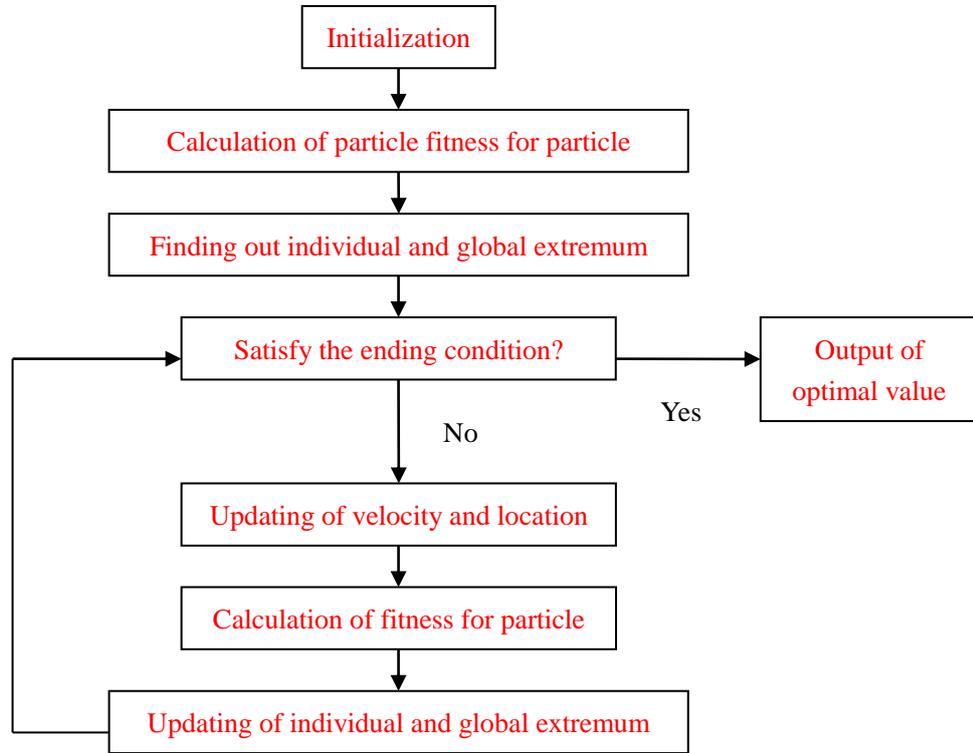


Figure 1. Procedure Diagram of Particle Optimal Algorithm

The basic steps of particle swarm algorithm are listed as follows:

(1) Initialization, a group of potential solutions and velocity of assigning particle can be generated randomly, and the group extremums of particle can be obtained.

(2) Updating of velocity and location, the particle can change in multi spaces through updating itself velocity, and updating of particle velocity is the process of dynamical regulation, and the updating of location can rely on the change of velocity, and the corresponding expressions can be expressed as follows:

$$\mathbf{V}^{k+1} = w\mathbf{V}_k + t_1r_1(\mathbf{P}_{optimal}^k - \mathbf{X}^k) + t_2r_2(\mathbf{G}_{optimal}^k - \mathbf{X}^k) \quad (7)$$

$$\mathbf{X}^{k+1} = \mathbf{X}^k + \mathbf{V}^{k+1} \quad (8)$$

where k denotes the current iteration time, w denotes the inertia weight, $\mathbf{P}_{optimal}^k$ denotes the optimal individual location of particle, $\mathbf{G}_{optimal}^k$ denotes the global optimal location, \mathbf{X} denotes the location of particle, \mathbf{V} denotes the velocity of particle, t_1 and t_2 are training factors, $t_1 \in [0,4]$, $t_2 \in [0,4]$, r_1 and r_2 are random numbers.

(3) Evaluation of optimal location of updating particle, the global extremum can be used as the optimal individual fitness.

(4) The optimal individual fitness of updating particle is compared with ending criterion, if the ending criterion is satisfied, the algorithm is over, and returns to step 2.

The adaptive evolutionary strategy is put forward based on ergodic property of chaotic sequence. Firstly every particle is introduced the personalized chaotic factor, which is expressed as follows:

$$\gamma(t) = \eta(z)\gamma(t-1)[1 - \gamma(t-1)] \quad (9)$$

where $\gamma(0) \in \text{rand}(0,1)$, $\mu(z) \in \text{rand}(3.75,4)$.

And the following relationships are constructed, which are listed as follows:

1) Personalized chaotic local training factor

$$c_1(t) = \begin{cases} c_1(t-1) - \gamma(t)S_{t_{c_1}}(1 + |\Delta E|), \text{Convergence state} \\ c_1(t-1) + \gamma(t)S_{t_{c_1}}|\Delta E|, \text{Diversified state} \\ \gamma(t)c_1(t-1), \text{Stagnant condition} \end{cases} \quad (10)$$

2) Personalized chaotic global training factor

$$c_2(t) = \begin{cases} c_2(t-1) - \gamma(t)S_{t_{c_2}}(1 + |\Delta E|), \text{Convergence state} \\ c_2(t-1) + \gamma(t)S_{t_{c_2}}|\Delta E|, \text{Diversified state} \\ \gamma(t)c_2(t-1), \text{Stagnant condition} \end{cases} \quad (11)$$

3) Personalized chaotic inertia coefficient

$$\omega(t) = \begin{cases} \omega(t-1) - \gamma(t)S_{t_\omega}(1 + |\Delta E|), \text{Convergence state} \\ \omega(t-1) + \gamma(t)S_{t_\omega}|\Delta E|, \text{Diversified state} \\ \gamma(t)\omega(t-1), \text{Stagnant condition} \end{cases} \quad (12)$$

where $S_{t_{c_1}}$, $S_{t_{c_2}}$ and S_{t_ω} are regulating step length.

In order to improve the global searching ability, few components in velocity vector of particle are carried out crossover and mutation operation. For random number in [0,1] of every dimension $r_g = (r_1^z, r_2^z, \dots, r_D^z)$, if r_g ($g = 1, 2, 3, \dots, D$) is less than mutation probability ρ_m , the corresponding operation is carried out for this component in velocity vector, which is expressed as follows:

$$v_g^z(t) = \begin{cases} v_g^z(t) + 2v_{\max}\rho_m, r_g^z \leq \rho_m \\ v_g^z(t), r_g^z > \rho_m \end{cases} \quad (13)$$

where v_g^z denotes the g th component of z th particle velocity component., v_{\max} denotes the maximum value.

The improved particle algorithm is introduced into the fuzzy clustering algorithm, and the corresponding procedure is listed as follows:

Step 1: Assignment of parameter: clustering number, fuzzy index, swarm scale, maximum inertia weight and minimum inertia weight are set, and the initial velocity of particle is set randomly, choosing c samples randomly as center of clustering make up of a particle, repeating this process until N particles are chosen.

Step 2: Calculation of fitness by the following expression:

$$fitness(i) = Sep(U; V; X) - Com(V; c) \quad (14)$$

$$Sep(U; V; X) = \sum_{i=1}^c u_{ij} \|v_i - v_j\|^2 \quad (15)$$

$$Com(V; c) = \exp\left[\sum_{i=1}^c \left(v_i - \frac{\sum_{i=1}^c v_i}{c}\right)\right] \quad (16)$$

Step 3: Choosing individual extremum and global extremum according to the fitness value.

Step 4: Updating the velocity and location of particle based on expression (7) and (8).

Step 5: Updating fitness value, if it satisfies with condition, the algorithm is over, otherwise returns to step 3.

3. Main Affecting Factors of Physical Ability of Basketball Player

The core physical agility is a kind of physical ability concludes size of the strength, action stability, and body balance reflected by relating abdominal muscles, back muscles, and small muscles in body during the procession of movement. Good and bad of the core physical agility are affected by the core muscles, and can be reflected by the core muscles finally. The core physical agility has an important effect on the movement of the people, which can be decided by the physiologic function of core muscles [6].

The core physical agility of the basketball players refers to the center position, abdominal muscles, back muscles and small muscles in the body showed by basketball players during the procession of training and match for achieving the predict technical action and strategies of the basketball team. The important indexes of basketball players are listed as follows:

(1) Heart rate

The heart rate is the speed of heart throbbing, which is an important good and bad index of body function. For other indexes, the heart rate has the characteristics of simple and easy to operate, and it is benefit for understanding the physical state of the basketball player, and controlling the strength of the sports load and training level, the basic heart rate is morning pulse of the basketball players, which can be used to measure the physical state of the basketball player and the strength of the sports load and training. When the basketball players experience the physical fatigue or discomfort, the heart rate will speed up or slow down suddenly. The basic heart rate shows higher stabilization and decreases, gradually, the basketball players often have the good physical state and proper sports load. When the sports load increases, the basic heart rate will rise, and the general changing amplitude is not more than six times. The heart rate during the procession of training and match has something with the sports load, the sports load strength can be evaluated by measuring the heart rate.

(2) Vital capacity

The vital capacity can reflect the respiratory function of body, and there are two determination methods of vital capacity, which are continuous vital capacity determination and time vital capacity determination respectively. The former method measure the vital capacity five times continuously, and the function of the respiratory muscle can be evaluated based on changing trend of five times testing results. if the next result is bigger than the first result, which shows the respiratory function is good, and the physical function is also good. Otherwise, the respiratory muscle is in the state of the fatigue, and the physical function state is poor, or the fatigue of the basketball player is not recovered [7].

(3) Hemoglobin

The hemoglobin index is mainly used to evaluate the athletic ability of the basketball players, the function state of the basketball player can be evaluated based on reflection of basketball players to the amount of exercise and exercise intensity in one to two weeks. The hemoglobin if the basketball players recover from low level to high level during the adjustment period after the basketball player carries an amount of exercises the basketball players feels good, and the basketball player can reflect the good aerobic capacity, and the hemoglobin value measured at this moment changes from 12 to 15 g/100mL, the Hematocrit value of the red blood cell is about 45%, and the physical function of the basketball player is in the good state. However, the hemoglobin value of male basketball player is lower than 12g/100mL, and the hemoglobin value of female basketball player is lower than 10g/100mL, the basketball coach should consider the regulation of sports load and proper nutrition supplement. Because the hemoglobin value of basketball players are different, and the hemoglobin content of the basketball player can not be evaluated based on the united normal standard. Therefore, the systematical and long time observation

should be carried out for different basketball players, and the optimal value of hemoglobin can be confirmed.

(4) Creatine

The creatine is also named as guanidine acetic acid, which is a basic part of cell, 95% of creatine in human body exists in bone cell, and it can play an important role in storing CP. After the basketball player take orally the creatine, the memory capacity of CP can improve 20%, the good effect can be obtained when it is used with glucose and bovine sulfonic acid. Taking creatine is important for basketball player, the ability to sprint with intermittent short time can be improved obviously, the generation of acid metabolic product in muscle can reduce, and the anaerobic endurance can be improved, the ability of muscle fibers making proteins can be improved, then the training effect of strength and speed can be strengthened [8].

The method supplying creatine for long time is listed as follows: supplying 15-25g creatines every day, and supplying creatines for 5-7 days, and then supplying 2-2.5g every day, and taking for 7-84 days, the effect is obvious, and the strength can be improved, the intermittent sprint with short time.

(5) Special amino acid

Amino acid is an important part of human body, the content of amino acid in muscle of human body occupies 80% of total quantity, there are many kinds of amino acids, the proportion of glutamine and taurine in bone muscle is very high, which has important role in regulating the protein synthesis, improving the working ability of muscle, and strengthening the immunocompetence.

The basketball player taking orally 2g glutamine every day during the period of big sports training, the strength, speed, endurance and stable number of red blood cell of basketball player can be improved obviously [9].

The basketball player taking orally arginine and ornithine during the period of heavy stress training, the secretion of growth hormone can be stimulated. However, the basketball sport itself can affect the secretion of growth hormone, therefore different people can obtain different using effect. Training load and physical state of basketball player should be considered, and the used properly.

4. Experimental Objective and Method

In order to analyze the effect of the nutrition method on the physical recovery and improvement of the basketball players, the corresponding experiment is carried out.

(1) Experimental aim

Forty basketball players are chosen as the experimental objectives to carry out the experiment, and the basic situation of the basketball players are listed in table 1.

Table 1. Basic Situation of the Basketball Players Chosen

	Male basketball players	Female basketball players
Number	20	20
Old/year	20 ± 1.6	19 ± 1.2
Height/cm	193 ± 12	171 ± 11
sport career age/year	6 ± 1.2	6 ± 1.3

(2) Researching method

Training plan: the male and female basketball players are divided into two groups respectively, which are experimental group and control group. The basketball players in the experimental group take the following nutrition methods:

(a) Fluid infusion

The fluid infusion mainly indicates supplying water and electrolyte, during the procession of training and match, the body temperature of basketball player increases, and

the excessive perspiration happens, then the lose of dehydrate and body electrolyte in body can be induced. The dehydrate can lead to the decreasing of blood capacity, and the load of heart can be added, lose of electrolyte can affect the cell membrane potential, then the sport ability of basketball player can reduce, therefore the proper method and in time fluid infusion should be taken for the basketball player during the procession of movement.

Fluid infusion uses isotonic drink concluding sugar and electrolyte, which concludes 0.9% of sodium chloride, 0.5% of amylaceum, and a certain amount of muriate of potash and magnesium aminosuccinate. 400-500 mL of fluid is supplied before movement, and 150-300 mL fluid is supplied when match is suspended.

(b) Carbohydrate supplementation

Sugar yuan reserve has something with physical ability of basketball player, generally the short time and intermittent limit strength sport can not rise the obvious consumption of glycogen, when the continuous movement time exceeds 40 minutes with 60%-80% maximum quantity of respiratory oxygen the muscle sSugar yuan can reduce obviously. The basketball sport is fit for the above characteristics, therefore it is necessary to concern the improvement of sugar yuan in body of basketball player and the physical ability recovery after movement, then the basketball player can have long time movement ability.

The low chitosan drink is used to supply sugar during the procession of movement, which can improve the continuous movement ability of basketball player obviously. After basketball movement, the constructive metabolism of sugar improve obviously, at this moment the supplements concluding oligosaccharide and amylogen is supplied, then the sugar yuan of body can be recovered.

(c) Supplement of alkali salt

After the basketball player carries out heavy load exercise, the PH value of blood reduces to 6.1, Phosphoric acid fructose kinase activity of glycolysis is restrained, the metabolism and energy supply process of sugar will changes slowly, then the movement ability of basketball player can reduce, therefore drink with baking soda and sodium phosphate, tertiary should be used for basketball player.

The basketball players in the control group do not use nutrition methods.

(6) Statistical analysis

All data is expressed by average number \pm standard deviation, and every index carries four times different obvious inspection (t inspection), the condition $P<0.05$ denotes that the difference has obvious significant meaning.

(6) Experimental parameters

The simulation program is compiled by MATLAB software, in order to verify the effectiveness of the new algorithm, the traditional particle swarm and improved particle swarm algorithms are used in this research. And the scale of particle swarm is equal to 20, the fuzzy index is equal to 2.

5. Results and Discussions

The iteration curves are show in Figure 2.

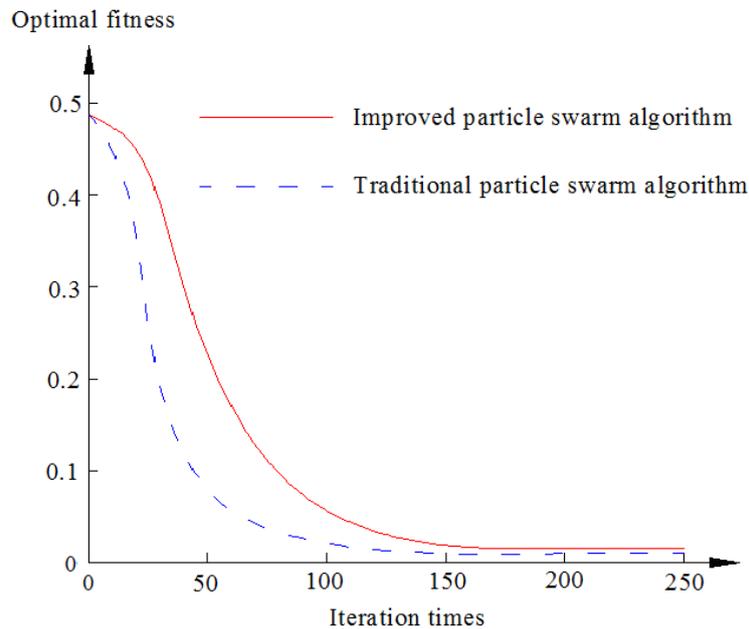


Figure 2. Iteration Curves Based On Improved and Traditional Particle Swarm Algorithm

As seen from Table 2, the traditional particle swarm algorithm is easy to fall into early premature, and the improved particle swarm algorithm can avoid this disadvantage, and the can obtain the optimal fitness.

Every indexes of experimental and control groups before training are shown in Table 2. And every indexes of experimental and control groups after training are shown in Table 3.

Table 2. Every Indexes of Experimental and Control Groups before Training

Item	Male basketball players		Female basketball players	
	Experimental group	Controlling group	Experimental group	Controlling group
Heart rate/(time/min)	184.4 ± 11.4	182.4 ± 11.6	172.0 ± 11.7	163.4 ± 8.78
Vital capacity/(ml)	46345 ± 539.3	47234 ± 497.2	35287 ± 337.2	37263 ± 452.2
Hemoglobin/(g/100ml)	14.65 ± 0.82	16.62 ± 0.77	11.49 ± 0.94	15.61 ± 0.72
Creatine /(mmol/L)	7.03 ± 1.33	5.71 ± 1.17	4.93 ± 0.87	4.72 ± 0.93
Special amino acid (mmol/L)	11.95 ± 1.13	15.29 ± 1.51	3.21 ± 0.52	6.30 ± 0.46

Table 3. Every Indexes of Experimental and Control Groups after Training

Item	Male basketball players		Female basketball players	
	Experimental group	Controlling group	Experimental group	Controlling group
Heart rate/(time/min)	189.6±12.4	179.3±10.4	183.7±11.5	172.6±11.32
Vital capacity/(ml)	47242±549.1	48435±552.5	38231±359.3	37953±451.7
Hemoglobin/(g/100ml)	15.189±0.93	19.45±0.83	15.671±1.26	18.56±0.83
Creatine /(mmol/L)	7.75±1.38	6.59±1.38	6.27±1.54	4.29±0.87
Special amino acid (mmol/L)	15.38±1.61	17.28±1.64	4.37±0.83	6.62±0.58

After training, every index of every group has the increasing trend, and the four times difference is no significant, and the heart rate and vital capacity of experimental and controlling group has significant difference, which is close to the obvious level of difference according to the statistical analysis ($P < 0.01$). The differences of hemoglobin, creatine and special amino acid in experimental and controlling groups is significant ($P < 0.05$).

6. Conclusions

At present, some excellent achievements relating to the nutrition measurements for basketball player have been obtained. The statistical analysis is carried out based on fuzzy clustering algorithm based on Monte Carlo T inspection. The nutrition measurements can improve the physical ability of the basketball player, and improve the immunity of the body of basketball player, and therefore it has wide developing view.

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