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## Logistic-based competitive aerobics athlete physical ability and technology development research

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### ABSTRACT

Due to competitive aerobics interestingness and fitness, it is favored by broad young people, it occupies very important roles in national fitness sports events, to improve competitive aerobics players comprehensive performances, it needs to go deeper analysis and researches on competitive aerobics athletes physical ability and technological levels. On this basis, the paper through questionnaire survey, mathematical statistics and other methods to analyze competitive aerobics players' lifestyle, training time, number of times and others, gets that competitive aerobics athletes participate in one time training per week occupies 57%, shows training times are fewer than to be improved, training time around 40 minutes occupies 60%, training time is arranged in the afternoon that conforms to body optimum training standard. After that, by utilizing logistic growth curve method, it makes prediction on one region aerobics athletes' amount, number of young competitive aerobics athletes, number of middle-aged competitive aerobics athletes and number of the senior competitive aerobics athletes have increased in five years after 2014, which verifies competitive aerobics will become more and more popular some time in future.

### KEYWORDS

Competitive aerobics; Physical ability and technology; Logistic growth curve method; Physiological indicator.



**INTRODUCTION**

In the middle period of last century, competitive aerobics started to widespread in the world, from which America and Japan respectively success hosting of two main competitions in 1983 and 1984 that built basis for competitive aerobics rapidly development, with improvements of people living standards, competitive aerobics are constantly expanding its impacts on every major sport competitions and is widely praised.

Regarding competitive aerobics research, formers have already made great contributions, such as Yang Fei-Fei had ever proposed to implement competitive aerobics training scheme in teaching in 2013, and by six months systematic training experiments to verify the scheme design’s scientificity and rationality:

Chang Sheng in regarding competitive aerobics athletes’ ability structure correlation analysis, according competitive aerobics features, applied questionnaire survey, documents literature and other methods to analyze factors that affected athletes’ abilities, finally got competitive aerobics would develop towards high completion type, high innovation type, high artistry type and high difficulty type, its each kind of technical motions would be more coordinated till perfect;

In 2013, Lin Hui applied experiment method, documents literature method, mathematical statistics method and logical analysis method to analyze competitive aerobics special class nine women university students and other majors nine women university students ankle joint features, got that competitive aerobics had well effects on ankle joint sports injury prevention and curing;

Dong Hui took Hebei province as an example, in competitive aerobics optional course students learning evaluation standards construction, he pointed out that current Hebei province competitive aerobics students’ learning status was not going well, and defined evaluation system, from which it contained emotions and attitudes, techniques and technology as well as other aspects, which provided evidence for defining standardized evaluation;

Gong Wen-Ping summarized straddle land to push up competitive aerobics action practical success experiences in 2008, made technical analysis of the action from sports biomechanics perspective, which provided scientific evidence for targeted training.

The paper firstly analyzes competitive aerobics athletes’ basic information, and then makes prediction on the change of number of Chinese competitive aerobics athletes in five years after 2014, and therefore gets rationalized conclusions. The research has extremely important significances in competitive aerobics theoretical researches sustainable development.

**MODEL ESTABLISHMENT**

Mathematical model is an important tool to solve practical problems, for competitive aerobics physical ability and technology research; we can analyze its data features through establishing mathematical model, and then predict Chinese competitive aerobics athletes’ amount status.

**Chinese competitive aerobics athletes’ activities ways**

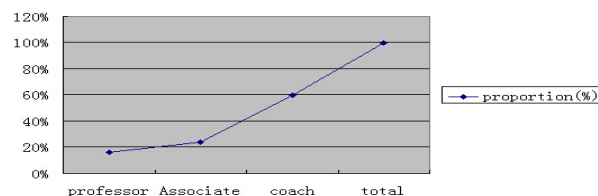
Competitive aerobics is the foundation of Chinese sports development. Research on Chinese competitive aerobics female population activities ways, genders structure and experts evaluation, it will helpful for Chinese sports further development, and find problems and solve problems in constantly development.

Main factors that affect competitive aerobics performing contain body shape type, function type, psychology type, technique type and so on, as TABLE 1.

**TABLE 1 : Multiple talents selection indicators**

Type	Event	Number of indicators
Psychology type	Standing stability and others	3
Technique type	Comprehensive sports and others	3
Body shape type	Height and others	3
Function type	View and others	5
Quality type	Cross jumping and others	6

In order to further research competitive aerobics athletes development status, now make further statistics of their coaches’ titles, and carry out comprehensive analysis, obtained result is as following Figure1 shows:



**Figure 1 : Experts titles statistics**

From the paper’s competitive aerobics athletes multiple talents selection indicators and experts statistical graphs, it is clear that quality type occupies five items of multiple items, coaches occupies 60% of job titles in experts statistics.

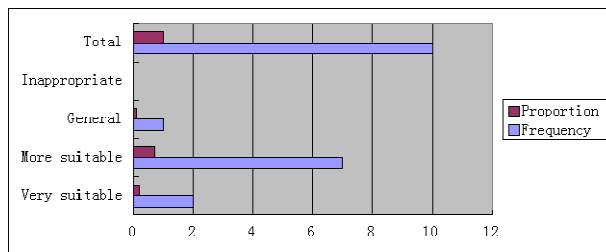
**Experts overall evaluation on athletes’ exercising investigation**

By several days’ interviewing and investigation, as well as going to Chinese competitive aerobics clubs, it makes concrete investigation and researches on professional competitive aerobics exercising status, list below TABLE 2.

**TABLE 2 : Statistical table of experts’ evaluation on investigation status**

Option	Very suitable	More suitable	General	Inappropriate	Total
Frequency	2	7	1	0	10
Proportion (%)	20%	70%	10%	0%	100%

In order to further analyze data features, now carry out statistical analysis, make research on TABLE 2 data, and draw following statistical figure:



**Figure 2 : Statistics experts to investigate the situation of the evaluation**

Above Figure 2 shows that experts think some of Chinese competitive aerobics clubs’ professional competitive aerobics exercises status entirely is relative fit for their physical quality.

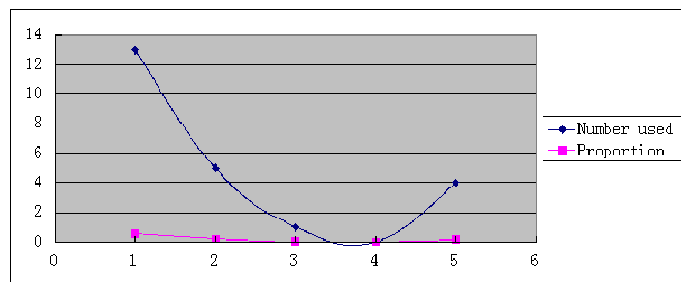
**Competitive aerobics training’s daily training status**

To do well in aerobics training cannot be realized in one day, carry out concreded contemporary investigation and research on Chinese competitive aerobics training time and training contents as TABLE 3.

**TABLE 3 : Statistics of number of physical training times per week**

	1time	2times	3 times	Above3 times	Not sure
Selection times	13	5	1	0	4
Proportion	57%	22%	4%	0	17%

To further analyze data features, now carry out statistical analysis, research on above TABLE 3 data, and draw following statistical Figure 3:



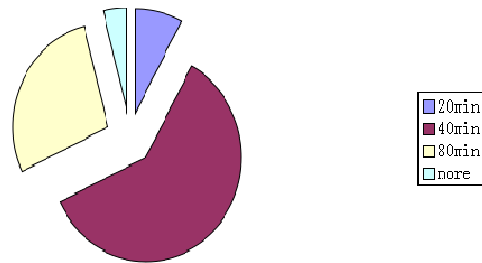
**Figure 3 : Weekly physical training frequency statistics**

In addition, the paper makes statistical analysis of aerobics athletes training time every time, and gets following TABLE 4 statistical results.

**TABLE 4 : Statistics of exercising time every time**

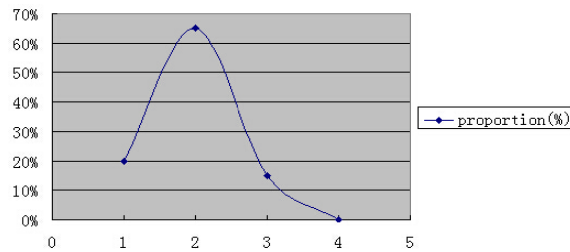
	20minutes	40 minutes	80 minutes	More
Selection times	2	15	7	1
Proportion	8%	60%	28%	4%

To further analyze data features, now carry out statistical analysis, research on above TABLE data, and draw following statistical Figure 4:



**Figure 4 : Exercise time chart each time**

In order to make reader more clear, the paper uses bar chart to make concrete analysis, researches on competitive aerobics physical training schedule, as following Figure 5 shows:



**Figure 5 : For physical training schedule**

The paper utilizes broken line figure, bar figure, scatter figure and other figures analysis, we can get that competitive aerobics athletes participate in one time training per week occupies 57% that shows training times are fewer that to be improved, training time around 40 minutes occupies 60%, training time is arranged in the afternoon that conforms to body optimum training standard.

**Logistic growth curve-based competitive aerobics system institution staff amount prediction**

By Logistic growth curve method, predict year 2015-2019 Chinese number of excellent competitive aerobics athletes and training techniques methods.

Things change rate is different in each period. Chinese sports system institution staff amount change trend is uncertain with time passing, here, introduce Logistic curve (growth curve), it has very wide application in such kind of uncertain development trend problems description.

Logistic curve general mathematical model is:

$$\frac{dy}{dt} = ry(1 - \frac{y}{L}) \tag{1}$$

Among them,  $y$  is predicted value,  $L$  is its limit value,  $r$  is growth constant, and  $r > 0$ . Solve the differential equation, finally it gets:

$$y = \frac{L}{1 + ce^{-rt}} \tag{2}$$

In the following, record Logistic curve general form as:

$$y_t = \frac{1}{K + ab^t}, K > 0, a > 0, 0 < b \neq 1 \quad (3)$$

Among them, in Logistic curve, parameter estimation makes following changes :  $Y_t' = \frac{1}{Y_t}$ , that:

$$y_t' = K + ab^t \quad (4)$$

For time sequence  $n$  pieces of corresponding observation value average divided three parts, and for every part, it has  $m$  periods, and then it has  $n = 3m$ .

Part one:  $y_1, y_2, y_3, \dots, y_m$ ;

Part two:  $y_{m+1}, y_{m+2}, y_{m+3}, \dots, y_{2m}$ ;

Part three:  $y_{2m+1}, y_{2m+2}, y_{2m+3}, \dots, y_{3m}$

Among them, every part trend sum is equal to corresponding observation values sum, therefore provide parameters estimation, three sums method steps are as following:

Record observation values each part sum is :

$$S_1 = \sum_{t=1}^m y_t', S_2 = \sum_{t=m+1}^{2m} y_t', S_3 = \sum_{t=2m+1}^{3m} y_t', \quad (5)$$

And it has:

$$\left\{ \begin{array}{l} S_1 = \sum_{t=1}^m \hat{y}_t = \sum_{t=1}^m (K + ab^t) = mK + ab(1 + b + b^2 + \dots + b^{m-1}) \\ S_2 = \sum_{t=m+1}^{2m} \hat{y}_t = \sum_{t=m+1}^{2m} (K + ab^t) = mK + ab^{m+1}(1 + b + b^2 + \dots + b^{m-1}) \\ S_3 = \sum_{t=2m+1}^{3m} \hat{y}_t = \sum_{t=2m+1}^{3m} (K + ab^t) = mK + ab^{2m+1}(1 + b + b^2 + \dots + b^{m-1}) \end{array} \right. \quad (6)$$

Among them:  $(1 + b + b^2 + \dots + b^{m-1})(b - 1) = b^m - 1$

And then it can get:

$$\left\{ \begin{array}{l} S_1 = mK + ab \frac{b^{m-1}}{b-1} \\ S_2 = mK + ab^{m+1} \frac{b^{m-1}}{b-1} \\ S_3 = mK + ab^{2m+1} \frac{b^{m-1}}{b-1} \end{array} \right. \quad (7)$$

Therefore, it can get:

$$\begin{cases} b = \left( \frac{S_3 - S_2}{S_2 - S_1} \right)^{\frac{1}{m}} \\ a = (S_2 - S_1) \frac{b-1}{b(b^m - 1)^2} \\ K = \frac{1}{m} \left[ S_1 - \frac{ab(b^m - 1)}{(b-1)} \right] \end{cases} \tag{8}$$

Besides, when predict data, it should test data, test method is:

$$\frac{y_{t+1} - y_t}{y_t - y_{t-1}} \approx b \tag{9}$$

By  $y'_t = \frac{1}{y_t}$ , it gets after changing year 20014~2019 data is as following TABLE 5:

**TABLE 5 : Data table after logistic curve changing**

		Years	2015	2016	2017	2018	2019
Number of people	Competitive aerobics young athletes		3479	3798	3981	4149	4596
	Competitive aerobics middle-aged athletes		1241	1377	1638	1828	2292
	Competitive aerobics senior athletes		129	138	151	189	199

According to formula (5), it gets:

$$S^1_1 = 0.682, S^1_2 = 0.614, S^1_3 = 0.377$$

Then by formula (8), it gets:

$$b^1 = 1.867, a^1 = -0.005111, K^1 = 0.35468$$

$$b^2 = 1.6999, a^2 = -0.0001453, K^2 = 0.1281$$

So obtained competitive aerobics system institution staff amount logistic growth curve mathematical model is:

$$\begin{cases} y^1_t = \frac{1}{0.35468 - 0.00511 \times 1.867^t} \\ y^2_t = \frac{1}{0.1281 - 0.0001453 \times 1.6999^t} \\ y^3_t = \frac{1}{0.0748 + 0.000796 \times 1.5128^t} \end{cases}$$

When predicting one region competitive aerobics systematic institution staff development changes in future five years after 2013, only need to input  $t$  value into above formula, as predict  $y_{2013}$ , then it has  $t = 2013 - 2004 + 1 = 10$ .

By above calculation result analysis, it gets conclusions: one region number of young competitive aerobics athletes, number of middle-aged competitive aerobics athletes and number of the senior competitive aerobics athletes have increased in five years after 2014, they are in the rising trend, indicates that Chinese competitive aerobics achieve certain effects in reformation, but Chinese person-time total amount is still smaller that to be further improved.

## CONCLUSION

① The paper analyzes competitive aerobics status, through questionnaire survey, mathematical statistics and other methods to analyze competitive aerobics players' lifestyle, training time, number of times and others, gets that competitive aerobics athletes participate in one time training per week occupies 57%, shows training times are fewer than to be improved, training time around 40 minutes occupies 60%, training time is arranged in the afternoon that conforms to body optimum training standard.

② In addition, for competitive aerobics exercising status, exercising time and time frame selection status, it makes researches, 70% experts think it relative suitable, which shows Chinese competitive aerobics orientation reformation effects are relative remarkable, which provides good development space for Chinese competitive aerobics future development;

③ Finally the paper through utilizing logistic growth curve method, it predicts one region aerobics athletes amount, gets that in future five years of 2015-2019, young competitive aerobics athletes amount, middle-aged competitive aerobics athletes amount and senior competitive aerobics athletes amount have increased, number of competitive aerobics athletes show a kind of gradually increasing trend, which proves competitive aerobics development some time in future will be more and more splendid.

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