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Fuzzy Comprehensive Evaluation on Chinese Aerobics Sports Industry Future Development

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Abstract: Aerobics is a kind of aerobic exercise, and combine with music and dance, which can improve participants' mind and body as well as moral quality, especially can cultivate person aesthetics and values. Modern aerobics initially was the physical training contents that human designed for astronauts to pedal towards outer space. While in the eighties, 20th century, with the globalization of information, aerobics as a kind of entertainment and fitness event, has rapidly developed in the world and formed into a fitness craze. People's pursuit of beauty and health lets aerobics to go further and further in the advanced scientific society. The paper researches on Chinese aerobics sports industry through fuzzy comprehensive evaluation, by fuzzy comprehensive evaluation value, it can get that Chinese aerobics sports industry development status is good, but there are still some room for improvement, with aerobics sports industry develops, Chinese aerobics undertaking will more rapidly develop.

Keywords: Aerobics, Biomechanics, Fuzzy comprehensive evaluation, Fitness effectiveness, Sports industry.

1. INTRODUCTION

In 1998, international aerobics league was founded in the world, included member states as Russia, Sweden, Ukraine, Britain, America, Denmark, Finland, Germany, Hungary, Japan, China's Taiwan and so on. Until 2004, there were 38 countries organizing and cultivating aerobics in the world [1].

Chinese aerobics undertakings are rapidly developing, research on the aspect of aerobics basic mechanics are fewer; the paper carries out mechanical research on aerobics according to aerobics difficulty rules, until 2000, China totally published above 1000 pieces of aerobics papers and textbooks as well as works, which indicated Chinese research on aerobics was gradually developing, and gradually formed into system. The paper firstly researches on aerobics undertaking technique of expression and action form in sports techniques as Table **1** show [2].

Secondly, according to international aerobics judgment criterion, analyze an aerobics athlete or an aerobics team, utilize evaluation model to calculate.

2. FUZZY EVALUATION MODEL ESTABLISHMENTS

Fuzzy comprehensive evaluation model is fit for fuzzy calculation that multiple factors are uncertain, the paper utilizes fuzzy comprehensive evaluation, and steps are as following:

At first, the paper establishes factor set

U: $U = (U_1 \quad U_2 \quad \cdots \quad U_k)$

Secondly, it establishes judgment set V (evaluation set):the paper establishes fuzzy mapping from judgment matrix U to judgment matrix V, it gets fuzzy relation as following matrix shows:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

The paper establishes weight set, $A = (a_1, a_2, \cdots, a_n)$, it meets conditions: $\sum_{i=1}^{n} a_i = 1 \quad a_i \geq 0$

Fuzzy relation R every line reflects the line influence factors to object judgment extent, and meanwhile, R every column reflects the column influence factors to object judgment extent.

$$\sum_{i=1}^{n} r_{ij} \quad j = 1, 2, 3, \cdots, m$$

Secondly, the paper carries out following calculation according to fuzzy comprehensive evaluation:

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$$B = A \cdot R$$

$$= (a_1, a_2, a_3, \cdots, a_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

$$= (b_1, b_2, b_3, \cdots, b_n)$$

In V, fuzzy combination is evaluation set B. Based on above described facts, actual change model that obtains by fuzzy comprehensive evaluation is as (Fig. **1**) shows:

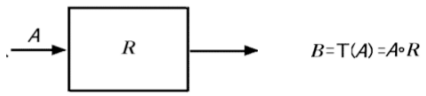

Fig. (1). Changed model.

According to (Fig. **1**) marking contents, it gets fuzzy comprehensive evaluation changed model so that can establish corresponding every factor grade evaluation transformation function, evaluation factors u1, u2, u3, u4, u5 membership functions can be expressed as following formula (1)、(2)、(3):

$$u_{v1}(u_1) = \begin{cases} 0.5(1 + \dfrac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 - \dfrac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0 \quad , & u_i < k_2 \end{cases} \tag{1}$$

$$u_{v2}(u_1) = \begin{cases} 0.5(1 - \dfrac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 + \dfrac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0.5(1 - \dfrac{u_i - k_3}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 - \dfrac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases} \tag{2}$$

$$u_{v1}(u_1) = \begin{cases} 0, & u_i \geq k_2 \\ 0.5(1 - \dfrac{k_1 - u_i}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 + \dfrac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases} \tag{3}$$

2.1. Combine with Fuzzy Evaluation Model to Evaluate Aerobics Players

Aerobics mainly focuses on teenagers, with the development of global competition, teenagers education has become key factors. However, physique of teenagers that are immersed in study has become key problems, with the phenomena multiplies, its health conditions become more serious. For aerobics future undertaking development, physique is more crucial, it decides aerobics future development in special aerobics education places.

By above model principles, it establishes factor set U, from which $U=(U_1\ U_2\ U_3\ U_4)$. Among them, sports school fitness facilities U_1, sports school educators cultivation U_2, sports curriculum organization cultivation U_3, and else U_4, it gets Table **2**. The paper establishes small factor set among four important factors sets.

By Table **2** listed factors, it gets evaluation set.

$$U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}\}$$

$$U_2 = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\}$$

$$U_3 = \{u_{31}, u_{32}, u_{33}\}$$

$$U_4 = \{u_{41}, u_{42}, u_{43}, u_{44}\}$$

By collecting data and analyzing, it gets sports school fitness facilities U_1, sports school educators cultivation U_2, sports curriculum organization cultivation U_3, and else U_4 four kinds of factors importance ranking statistics, as Table **3** show.

By sorting out Table **3**, it gets sports school fitness facilities U_1, sports school educators cultivation U_2, sports curriculum organization cultivation U_3, and else U_4 four aspects rank matrix.

$$U_2 = \{23, 7, 4, 0\}$$

$$U_2 = \{7, 18, 8\ 0\}$$

$$U_3 = \{0, 9, 13, 12\}$$

$$U_4 = \{3, 0, 9, 21\}$$

Obtained weighted vector from rank 1 to rank 2:

$$\beta = \{\beta_1, \beta_2, \beta_3, \beta_4\} = \{0.4, 0.3, 0.2, 0.1\}$$

$$U_i^* = U_i \cdot \beta^T$$

$$U_1^* = 14, \ U_2^* = 9.4, \ U_3^* = 4, \ U_4^* = 5.6$$

The paper takes normalization processing:

$$U_1^* = 0.35, \ U_2^* = 0.3, \ U_3^* = 0.2, \ U_4^* = 0.15$$

It gets: $\bar{A} = (0.35 \quad 0.3 \quad 0.2 \quad 0.15)$

The paper establishes remarks membership, as Table **4** shows.

By Chinese aerobics sports industry future development cultivation obtained evaluation on sports school fitness facilities U_1, sports school educators cultivation U_2, sports curriculum organization cultivation U_3, and else U_4 four aspects indicators, the paper gets Table **5**.

Table 1. Classification of competitive aerobics elements of difficulty.

Classification of aerobics elements of difficulty	Dynamic motion	Jumping type	
		Twisting type	
		Inverting type	
		Leg swinging type	
		Picked type	
	Static posture and vigorous motion	Vigorous motion	
		Static posture	Balance
			Support
			Split
			Lift

Table 2. Chinese aerobics sports industry future development evaluation indicator system.

Sports school fitness facilities U_1	Sports school educators cultivation U_2	Sports curriculum organization cultivation U_3	Else U_4
Sports school internal facilities introduction u_{11}	Coaches cultivation u_{21}	Sports events u_{31}	Sports viewing and emulating u_{41}
Sports school internal facilities maintenance u_{12}	Faculty cultivation u_{22}	Extracurricular activity u_{32}	Physical education development u_{42}
Competition facilities construction u_{13}	Competition introduction u_{23}	Physical education course lecturing u_{33}	Fusion with traditional physical education u_{43}
Daily facilities construction u_{14}	Sports personnel cultivation fee u_{24}	Game u_{34}	
Equipment changing u_{15}			

Table 3. Four kinds of factors importance degree ranking statistics.

Classification	Rank1	Rank 2	Rank 3	Rank 4
Sports school fitness facilities U_1	23	7	4	0
Sports school educators cultivation U_2	0	0	15	18
Sports curriculum organization U_3	0	9	13	12
Else U_4	3	21	9	0

Table 4. Established remarks membership.

Evaluation way	Set Scores Interval			
	0-60	60-80	80-90	90-100
Excellent	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Medium	0.05	0.9	0.05	0
Poor	0.95	0.05	0	0

Table 5. Chinese aerobics sports industry future development all kinds of indicators obtained evaluation values.

Each Layer Indicator	Evaluation Value	Each Layer Indicator	Evaluation Value
Sports school internal facilities introduction u_{11}	Excellent	Sports events u_{31}	Good
Sports school internal facilities maintenance u_{12}	Excellent	Extracurricular activity u_{32}	Good
Competition facilities construction u_{13}	Medium	Physical education course lecturing u_{33}	Good
Daily facilities construction u_{14}	Medium	Game u_{34}	Medium
Equipment changing u_{15}	Medium	Sports viewing and emulating u_{41}	Poor
Coaches cultivation u_{21}	Excellent	Physical education development u_{42}	Medium
Faculty cultivation u_{22}	Excellent	Fusion with traditional physical education u_{43}	Poor
Competition introduction u_{23}	Good		
Sports personnel cultivation fee u_{24}	Good		

By above model, it gets single layer indicator weight factor fuzzy set is:

$$U_1^* = \{U_{11}, U_{12}, U_{13}, U_{14}, U_{15}\} = \{0.25\ 0.25\ 0.2\ 0.15\ 0.15\}$$

$$U_2^* = \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.54\ 0.1\ 0.24\ 0.14\}$$

$$U_1^* = \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.4\ 0.3\ 0.1\ 0.2\}$$

$$U_1^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3\ 0.4\ 0.3\}$$

By Table **5** evaluation, and combine with Table **4** remarks membership, the paper gets sports school fitness facilities U_1, sports school educators cultivation U_2, sports curriculum organization cultivation U_3, and else U_4 each aspect evaluation set:

Sports school fitness facilities

$$U_1 = \begin{pmatrix} 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0 \\ 0 & 0.05 & 0.95 & 0 \\ 0 & 0.05 & 0.95 & 0 \end{pmatrix}$$

Sports school educators' cultivation

$$U_2 = \begin{pmatrix} 0.05 & 0.90 & 0.05 & 0 \\ 0.05 & 0.90 & 0.05 & 0 \\ 0 & 0.95 & 0.05 & 0 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

Sports curriculum organization

$$U_3 = \begin{pmatrix} 0.05 & 0.95 & 0.05 & 0 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

Else

$$U_4 = \begin{pmatrix} 0.05 & 0.95 & 0.05 & 0 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

For above evaluation set, it calculates according to following formula: $B_i = A_i \cdot R_i$

Make normalization processing with obtained B_i, it gets fuzzy evaluation matrix.

$$\bar{B} = \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = \begin{pmatrix} 0.07 & 0.26 & 0.13 & 0.42 \\ 0 & 0.15 & 0.76 & 0.54 \\ 0.14 & 0.24 & 0.21 & 0.17 \\ 0.14 & 0.2 & 0.3 & 0.36 \end{pmatrix}$$

It gets comprehensive evaluation value:

$$Z = U^* \cdot B = (0.16 \quad 0.39 \quad 0.24 \quad 0.21)$$

By result indication, it gets $0.39 > 0.24 > 0.21 > 0.16$

CONCLUSION

Aerobic exercises functions are different with its types, but performances are for improving one's own physique, cultivating one's taste, perfecting bodily form and keeping psychological health and so on. Aerobics require that motion should be standard and full of elasticity, and good sense of rhythm. Free-hand exercise motions as basic motions of aerobics, which are composed of head, neck, chest, waist, upper and lower limbs these five parts, basic forms are extending, bending, circling, twisting, swinging, lifting and flapping. Among them, it represents as wave motions, swinging, extension and flexion, twisting, circling, leapfrogging and dance steps and so on.

By fuzzy comprehensive evaluation values, the paper can get that Chinese aerobics sports industry development status is good, but it still has some room of improvement, with the

development of aerobics sports industry, Chinese aerobics undertaking surely will become better and better.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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None declared.

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