Application of Fuzzy Mathematics in Physique Comprehensive Evaluation of College Students

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Abstract—The theory of fuzzy mathematics is widely used in comprehensive evaluation. In this paper, physical fitness index will be evaluated comprehensively with the fuzzy comprehensive evaluation method. First, we establish a fuzzy mathematical model of a physical comprehensive evaluation. Then, perform a simulation example of the established mathematical model. Experimental results show that the model has a high objectivity and feasibility of comprehensive evaluation of physique and such evaluation method will facilitate PE decision makers with reliable mathematical model on the research of comprehensive physical fitness from the perspective of quantization.

Keywords—Physique Comprehensive Evaluation, Fuzzy Mathematics, Evaluation of Coefficient Matrix, Evaluation of the Weight Vector, College Students

I. INTRODUCTION

The national physique is one of the important aspects which constitute the population and the comprehensive qualities in a country[1]. From the momentous statistical literature of different countries, we all have seen the relevant contents, such as the nationwide fitness, the mass sports and so on, which indicates that the social development index system of the state has an urgent request to the national physical condition and its development[2,3] . But because of various reasons, we don't collect relevant information of the national physique based on the national physique monitoring. On the other hand, with the development of the continuous improvement of social productivity and the economic, more people begin to pay close attention to the physical and mental health and they begin to comprehend that the physical health is a vital aspect of the national comprehensive quality and that the physical fitness play a crucial role in the personal development[4] . Now there are a lot of researches about the evaluation of physical fitness and health both at home and abroad, such as document to calculate the correlation coefficient between each evaluation index of physical health by mathematical statistic method according to the height and standard weight group and document to set up the evaluation index system of physical monitoring through the facilities index, the sustaining system environment index, the comprehensive management index and the physical and mental constructs evaluation index[5] . However, most of them just give a qualitative judgment to the physique instead of giving a quantified evaluation[6] . Everyone is looking forward to getting a quantitative evaluation after receiving a comprehensive evaluation of multiple range. Therefore, it is urgent to establish a mathematical model for comprehensive evaluation of physique quantization. This paper uses the fuzzy comprehensive evaluation to model the problem, establishing the above-mentioned model, which can give the scores of the tested objectively and quantitatively to provide theoretical guidance and reference for the physical exercise.

II. THE TRADITIONAL METHOD OF COMPREHENSIVE EVALUATION OF PHYSIQUE

From the numerous methods of comprehensive evaluation of physique, the basic forms of the mathematical models which they built can be various. And it is widely used to give a comprehensive evaluation to the physique by establishing an index mathematical model. It is a way to confirm the max and the min to every index to find the relative locations of the present collecting sample data in this interval and then average all the indexes and get the total composite index. The basic mathematical idea of this algorithm is the comprehensive score; the score interval is the maximum value and the minimum value of the index and the mathematical model [3] is:

$$CI = \sum p_j f_i \sum K_i(x_{ij}/x_i) \qquad (1)$$

In the formula i is the index; j is the individual grouping; p_j is the population age structure weight; K_i is the weight of each index; x_i is the average value of single index test for the base period; x_{ij} is the average value of the single index test for the reporting period; f_i is the regulatory factor.

This scheme is characterized by the single index structure, which is concise and explicit and it is easy to understand because the index has the reality significance. Its difficulty is that the constitution is a multi-dimensional system with rich connotation and every index, complex, in the index system changes with the age. So, it is difficult to ensure the single representative index and the representative age bracket. Own to the physique comprehensive evaluation model based on the fuzzy mathematics theory, this paper can perfectly avoid the difficulties of the traditional model to facilitate the physique comprehensive evaluation with a higher objectivity and feasibility.

III. ESTABLISH THE MATHEMATICAL MODEL BASED ON THE FUZZY MATHEMATICS

Construct an evaluation structure of physical fitness. There are few aspects to affect one's physical fitness assessment. So, a group of experts will be needed to find the most important factors which have an influence on the evaluation of physical fitness and health and give every factor a remark grade and operate the weight vector influenced by the physique from every factor through the way of Analytical Hierarchy Process (AHP) document [7,8].

Construct an evaluation of coefficient matrix. Invite the experts to give a mark to the comment of every evaluating indicator and ensure the evaluation index of coefficient matrix R

$$R = \begin{pmatrix} r_{1i} \\ r_{2i} \\ \cdots \\ r_{ni} \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nn} \end{pmatrix} \tag{2}$$

Calculating the evaluation of the weight vector by calculating the following formula:

$$W = V \otimes R = (w_1, w_2, w_3, \cdots, w_n) \tag{3}$$

normalize the weight vector and then get the one's physique score by multiplying 100 by the value, the sum of the weight vectors which are the representatives of the better and the above level.

IV. EXAMPLE SIMULATION

Now give a comprehensive evaluation to a student from the department of mathematics and a student from the department of physical education of the same college. By consulting the doctor of the college clinic and the professional adviser of physique test of the department of physical education, we know that there several significant factors influencing comprehensive evaluation of human body, which are lung capacity, weight for standard height, step test, hand-grip test, Sit-up and Long jump.

Calculating their weight vectors with AHP:

$$v = (0.2, 0.15, 0.2, 0.1, 0.2, 0.15) \tag{4}$$

The adviser of physique test gives an evaluation according to the test score of A, as table 1.

TABLE 1 THE TEST SCORE OF A

	Lung Capacity	Weight for Standard Height	Step Test	Hand-grip Test	Sit-up	Long Jump
Weight Vectors	0.2	0.15	0.2	0.1	0.2	0.15
Score	75	80	74	85	65	75
Excellent	0.7	0.8	0.75	0.8	0.65	0.8
Good	0.25	0.15	0.15	0.2	0.2	0.1
Pass	0.05	0.05	0.05	0	0.15	0.1
Fail	0	0	0	0	0	0

Calculating the evaluation of the weight vector:

$$W = V \otimes R$$

$$= \begin{pmatrix} 0.2 \\ 0.15 \\ 0.2 \\ 0.1 \\ 0.2 \\ 0.15 \end{pmatrix}^T \otimes \begin{pmatrix} 0.7 & 0.25 & 0.05 & 0 \\ 0.8 & 0.15 & 0.05 & 0 \\ 0.75 & 0.15 & 0.05 & 0 \\ 0.8 & 0.2 & 0 & 0 \\ 0.65 & 0.2 & 0.15 & 0 \\ 0.8 & 0.1 & 0.1 & 0 \end{pmatrix} = (0.74, 0.1775, 0.0725, 0) \tag{5}$$

Normalizing the weight vector:

$$W = (0.747, 0.179, 0.074, 0) \tag{6}$$

From the above calculation, we know that the good weight vector of this person is 0.747; the better one is 0.179. So, the final score of this person is 85.99 if we take the better weight vector and the above level as a standard.

The evaluation of test score of the other person B is shown in table 2

TABLE2 THE TEST SCORE OF B

	Lung Capacity	Weight for Standard Height	Step Test	Hand-grip Test	Sit-up	Long Jump
Weight Vectors	0.2	0.15	0.2	0.1	0.2	0.15
Score	80	75	76	84	64	75
Excellent	0.75	0.8	0.7	0.8	0.75	0.8
Good	0.15	0.2	0.15	0.1	0.15	0.15
Pass	0.1	0	0.15	0.1	0.1	0.05
Fail	0	0	0	0	0	0

Calculating the evaluation of the weight vector:

$$W = V \otimes R \tag{7}$$

$$= \begin{pmatrix} 0.2 \\ 0.15 \\ 0.2 \\ 0.1 \\ 0.2 \\ 0.15 \end{pmatrix}^T \otimes \begin{pmatrix} 0.75 & 0.15 & 0 & 0 \\ 0.8 & 0.2 & 0 & 0 \\ 0.7 & 0.15 & 0.15 & 0 \\ 0.8 & 0.1 & 0.1 & 0 \\ 0.75 & 0.15 & 0.1 & 0 \\ 0.8 & 0.15 & 0.05 & 0 \end{pmatrix} = (0.76, 0.1525, 0.0675, 0) \tag{8}$$

Normalizing the weight vector:

$$W = (0.776, 0.183, 0.041, 0) \tag{9}$$

From the calculation, we know that the good weight vector of this person is 0.776; the better one is 0.183.So, the final score of this person is 87.35 if we take the better weight vector and the above level as a standard. By comparing the two scores, we

find that B's physique is better than A's because the comprehensive physical score of B is higher that of A. If we just sum every score and get the average score, we'll find that they have the same score, namely B's physique is as good as A. However, the fact is B's physique is better than A. Therefore, it is not scientific to judge it is good or bad of someone's comprehensive physique by summing and getting the average value. But using this model can objectively assess the quality of an individual physique.

V. CONCLUSIONS

The application result of the above model shows that this evaluation model can well solve the problem that we only can give a qualitative evaluation but using the method of quantitative analysis when giving an evaluation of someone's physical quality. The evaluation, by this way, becomes more clear and intuitive. For one's physical fitness assessment, it is extremely complicated and fuzzy. Every investigator researching the physique evaluation hopes to make a best evaluation model in consideration of various factors as soon as possible. Considering most of the evaluations are fuzzy, it is a real and scientific means to evaluate with the comprehensive evaluation method of fuzzy mathematics. And in this paper, such model is highly practical, combined with the fuzzy mathematics and AHP. By calculating the weight vector, we realize that the vital capacity level plays the most important role in one's physique; the second is the weight for standard height and the sit-up; the last one is the step. As a result, it can be emphasized on this aspect when exercising ourselves at normal times.

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