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## The study on the construction and empirical of China youth physical health comprehensive evaluation system

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### ABSTRACT

This paper established the youth physical health comprehensive evaluation system through five indicators. The five indicators are health defect, quality, psychological, function and body shape. Next, it established the weight assessment evaluation model to calculate the weights of the five indicators. Then it judged the evaluation level through hierarchical analysis method, in order to health comprehensive evaluation. After that it conducted a holistic assessment on the boys in Guangzhou and Xiangtan through the method of fuzzy mathematics. And it calculated the index level distribution of all ages. Finally, the tested theoretical results are in accordance with the actual situation.

### KEYWORDS

Youth sports; Comprehensive evaluation; Physical health; Fuzzy evaluation.



## INTRODUCTION

Health is a comprehensive holistic concept. It not only refers to the absence of disease and infirmity, also related to the physical and psychological state to adapt the situation. The comprehensive evaluation of youth physical health not only involves the individual itself, but also more important to the national future and destiny. Therefore, the study of the physical health of youth has important significance for the future development of our motherland.

As early as the eighties, China's ministry of health, ministry of education and national sports commission and other relevant departments did the research about national youth health. The research includes the psychological factors, physical function, and human form and so on. The research is mainly based on comprehensive evaluation method to evaluate, but it must comply with two basic conditions; one is to improve the comprehensive use of existing historical data; Second, it must have equivalent information in it. In previous study, fuzzy mathematical model for clustering analysis, grey correlation model of principal component analysis model and the method of weighted comprehensive evaluation is used to study the problem.

In this paper, further analysis and research has been done on the basis of predecessors' research. Evaluation also has been made through the literature material method, mathematical statistics method and fuzzy evaluation method. This paper made theoretical preparation for the further research in this field.

## CONSTRUCTION OF YOUTH PHYSICAL HEALTH EVALUATION

The evaluation of youth physical health involves many factors, due to the trend and generality of comprehensive evaluation, the evaluation is also comprehensive and fuzzy. Therefore, construct a reasonable physical health of adolescents, to determine the ambiguity of the relationship between each other, so that to achieve the quantitative analysis. The determination of each indicators of the youth physical health evaluation is shown in TABLE 1.

**TABLE 1 : The index of comprehensive evaluation on youth physical health**

Comprehensive evaluation on youth physical health	Mental state	Living quality
	physiological function	Vital capacity index
	Morphological development	Body mass index
		Endurance run
	Sport quality	Standing jump
		50m run
	Health defects	Students' common diseases

### The determination of each index in the evaluation system

This paper takes the comprehensive study group of youth physical health as the background of weights, refer to the related literature at home and abroad, Use AHP method to establish evaluation index weight and quantify it. The determination results about the weights of the five chosen index are shown in TABLE 2 below.

**TABLE 2 : The distribution table about the weight indicator of the five indexes**

Indicator categories	Specific indicators	Weight ( $w_i$ )
physiological function	Vital capacity index	0.1535
Body shape	Body mass index	0.1535
Mental	Living quality	0.0231
Health defects	Heart, spleen and kidney disease, Malnutrition, poor eyesight and other diseases	0.3144
	50m run (s)	0.0750
Physical fitness	standing jump (cm)	0.0750
	Endurance run (s)	0.0750

Total

1.0000

**Standardization of each index**

In real life, evaluate the multi-attribute index after standardization; in order to eliminate the differences between the different amounts which can't be compared with, this paper standardized the target. Namely, dimensionless the various indicators, the process also called Standardization. Then divide it into upper, middle upper, middle low and lower, these five classes. Next, determine the Score sheet of youth physical health state in various regions of China. This paper chose Guangzhou and Xiangtan as the research object. As shown in TABLE 3.

**TABLE 3 : The score sheet of youth physical health rank**

Rank	Upper	Middle upper	Middle	Middle low	Lower
Health defects	= 100	97 ~ 99	88 ~ 96	80 ~ 87	< 80
Standard score	90	80	70	60	50

**TABLE 4 : Ranking table of Guangzhou and Xiangtan**

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)
Xiangtan	1505	20	1.90	248	23.3	555	52.7	213	20.3	17	1.61
Guangzhou	1125	29	2.58	219	19.4	514	45.6	316	28.0	47	4.18

**TABLE 5 : Ranking table of physical function index**

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)
Xiangtan	1053	141	13.39	425	40.36	411	39.03	73	6.93	4	0.38
Guangzhou	1125	143	12.71	524	46.58	420	37.33	34	3.02	4	0.3

**TABLE 6 : Ranking table of physical fitness**

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)
Xiangtan	1053	0	0.00	36	3.42	293	27.83	698	66.29	27	2.56
Guangzhou	1125	9	0.80	355	31.56	618	54.93	136	12.09	7	0.62

**TABLE 7 : Ranking table of mental health**

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)
Xiangtan	1053	3	0.28	65	6.17	865	82.15	102	9.69	19	1.80
Guangzhou	1125	50	4.44	231	20.53	756	67.20	73	6.49	15	1.33

**TABLE 8 : Ranking table of health defects**

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number	rate	Number	rate	Number	rate	Number	rate	Number	rate

		of people	(%)	of people	(%)	of people	(%)	of people	(%)	of people	(%)
Xiangtan	1053	284	26.97	99	6.17	464	44.06	180	17.09	27	2.56
Guangzhou	1125	179	15.91	115	20.53	553	49.16	233	20.71	45	4.00

TABLE 9 : Comprehensive evaluation form of Guangzhou and Xiangtan

Area	Number of people	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)	Number of people	rate (%)
Xiangtan	1053	38	3.61	250	6.17	523	49.67	194	18.42	49	4.65
Guangzhou	1125	90	8.00	232	20.62	621	55.20	155	13.78	27	2.40

From the table above, we can see that after comparing Guangzhou with Xiangtan for the five indexes, we can see that in the health defect, Xiangtan account for the largest proportion of “upper” in the Health defect, Guangzhou accounts for the largest proportion of “lower”. In the mental health, Guangzhou accounts for the largest proportion of “upper”, Xiangtan accounts for the largest proportion of “lower”. In the physiological function, Xiangtan accounts for the largest proportion of “lower”. In body shape, Guangzhou accounts for the largest proportion of “upper ”and“lower”. In the comprehensive evaluation form, Guangzhou accounts for the largest proportion of “upper”, Xiangtan accounts for the largest proportion of “lower”.

## THE COMPREHENSIVE EVALUATION METHOD OF YOUTH PHYSICAL HEALTH

In order to evaluate the youth physical health more reasonably, this paper chose Guangzhou and Xiangtan as the research object. As shown in TABLE 10-11.

TABLE 10 : Test Results of Guangzhou boys physical health

Gender	Index	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	%	Number of people	%	Number of people	%	Number of people	%	Number of people	%
Male	Body mass index	3	4.05	12	16.2	32	43.2	22	29.7	5	6.76
	Vital capacity index	10	13.5	34	45.9	27	36.4	3	4.05	0	0.00
	Physical fitness	0	0.00	12	16.2	46	62.1	16	21.6	0	0.00
	Health defects	41	55.4	27	36.4	6	8.11	0	0.00	0	0.00
	living quality	4	5.41	22	29.7	43	58.1	5	6.76	0	0.00

TABLE 11 : The test results about the physical health of boys in Xiangtan

Gender	Index	Upper		Middle upper		Middle		Middle low		Lower	
		Number of people	%	Number of people	%	Number of people	%	Number of people	%	Number of people	%
Male	Body mass index	1	0.00	49	92.45	4	7.55	0	0.00	0	0.00
	Vital capacity index	39	73.58	14	26.42	0	0.00	0	0.00	0	0.00
	Physical fitness	0	0.00	22	41.51	24	45.28	7	13.21	0	0.00
	Health defects	1	0.00	7	13.21	34	64.15	12	22.64	0	0.00
	living quality	6	0.00	7	13.21	45	84.91	1	1.89	0	0.00

First, determine the factors set  $U = \{\text{Health defects, living quality, Physical fitness, Vital capacity index, Body mass index}\}$ , Secondly, establish the evaluation set  $V$  (Evaluation set),  $V = \{\text{Upper Middle upper Middle, Middle low, Lower}\}$ , establish each index into the state of fuzzy matrix  $R$  of  $U \times V$ . Next, take the 15 years boys in Guangzhou and Xiangtan as example to do study, then the fuzzy matrix  $R$  can be obtained,

$$\text{Guangzhou boys R: male} = \begin{pmatrix} 0.0408 & 0.1622 & 0.4324 & 0.2973 & 0.0676 \\ 0.1351 & 0.4595 & 0.3649 & 0.0405 & 0.0000 \\ 0.0000 & 0.1622 & 0.6216 & 0.2162 & 0.0000 \\ 0.0542 & 0.2973 & 0.5811 & 0.0676 & 0.0000 \\ 0.5542 & 0.3649 & 0.0811 & 0.0000 & 0.0000 \end{pmatrix}$$

$$\text{Xiangtan boys R: male} = \begin{pmatrix} 0.0000 & 0.2432 & 0.5946 & 0.1352 & 0.0270 \\ 0.0270 & 0.2973 & 0.5676 & 0.1082 & 0.0000 \\ 0.0270 & 0.2162 & 0.5946 & 0.1622 & 0.0000 \\ 0.1622 & 0.2973 & 0.5135 & 0.0270 & 0.0000 \\ 0.7297 & 0.2432 & 0.0270 & 0.0000 & 0.0000 \end{pmatrix}$$

Due to the error between individuals, this paper take the boys of 13-15years and 16-18years in Guangzhou and Xiangtan as the objects, the result is shown below:

The evaluation matrix  $R$  of Guangzhou boy is :

$$13-15\text{age} = \begin{pmatrix} 0.0119 & 0.2025 & 0.5000 & 0.2619 & 0.0238 \\ 0.1865 & 0.4246 & 0.3810 & 0.0000 & 0.0079 \\ 0.0159 & 0.3690 & 0.5079 & 0.0992 & 0.0079 \\ 0.0159 & 0.1230 & 0.7500 & 0.0952 & 0.0159 \\ 0.3056 & 0.5755 & 0.1151 & 0.0040 & 0.0000 \end{pmatrix}$$

$$16-18\text{age} = \begin{pmatrix} 0.0171 & 0.1552 & 0.4353 & 0.3664 & 0.0259 \\ 0.1079 & 0.5086 & 0.3491 & 0.0302 & 0.0043 \\ 0.0129 & 0.3922 & 0.4914 & 0.0991 & 0.0043 \\ 0.0043 & 0.1034 & 0.7672 & 0.0948 & 0.0302 \\ 0.2112 & 0.5948 & 0.1897 & 0.0043 & 0.0000 \end{pmatrix}$$

The evaluation matrix  $R$  of Xiangtan boy is :

$$13-15\text{age} = \begin{pmatrix} 0.0350 & 0.1595 & 0.4864 & 0.2724 & 0.0468 \\ 0.1284 & 0.2763 & 0.4981 & 0.0895 & 0.0079 \\ 0.0000 & 0.0700 & 0.7665 & 0.1556 & 0.0078 \\ 0.0195 & 0.1051 & 0.7354 & 0.1051 & 0.0350 \\ 0.4202 & 0.4669 & 0.1051 & 0.0078 & 0.0000 \end{pmatrix}$$

$$16-18age = \begin{pmatrix} 0.0304 & 0.2045 & 0.4838 & 0.2429 & 0.0384 \\ 0.1397 & 0.2753 & 0.4615 & 0.1154 & 0.0080 \\ 0.0000 & 0.0162 & 0.7490 & 0.2348 & 0.0000 \\ 0.0101 & 0.1113 & 0.7470 & 0.1032 & 0.0283 \\ 0.2389 & 0.5729 & 0.1781 & 0.0101 & 0.0000 \end{pmatrix}$$

Secondly establish weight set  $A = \{0.1534, 0.1536, 0.224, 0.1536, 0.3144\}$ , Through the multiplication of matrix composite situation to establish the fuzzy evaluation set  $B_{\text{男}} = A \circ R_{\text{男}}$ , So the fuzzy evaluation set in these two places for:

$$\tilde{B}_{\text{guangzhou male}} = \tilde{A} \circ \tilde{R}_{\text{male}} = (0.209467, 0.292286, 0.376942, 0.11087, 0.01037)$$

$$\tilde{B}_{\text{zhuzhou male}} = \tilde{A} \circ \tilde{R}_{\text{male}} = (0.2336, 0.395, 0.3199, 0.0931, 0)$$

These two teen age is similar to the above process, the result is:  
Guangzhou

$$B = \tilde{A} \circ \tilde{R}_{13-15age} = (0.1326 \quad 0.3791 \quad 0.4008 \quad 0.0784 \quad 0.0091)$$

$$B = \tilde{A} \circ \tilde{R}_{16-18age} = (0.0892 \quad 0.3930 \quad 0.4084 \quad 0.0991 \quad 0.0102)$$

Xiangtan

$$B = \tilde{A} \circ \tilde{R}_{13-15age} = (0.2355 \quad 0.2251 \quad 0.3586 \quad 0.1671 \quad 0.0137)$$

$$B = \tilde{A} \circ \tilde{R}_{16-18age} = (0.1923 \quad 0.2615 \quad 0.3649 \quad 0.1662 \quad 0.0150)$$

On the basis of the above two areas of judgment result of fuzzy evaluation, the “upper” accounts for the largest proportion, the result of comprehensive evaluation of the boys is “middle”.

The evaluation factors set evaluation scores given that:  $p = (90 \quad 80 \quad 70 \quad 60 \quad 50)$ , acquire the overall evaluation scores through the form of matrix, then  $C = B \circ P$ , the results in the two corresponding regions are as follows:

$$C_{\text{guangzhou male}} = (90 \quad 80 \quad 70 \quad 60 \quad 50) \circ \begin{pmatrix} 0.20946799 \\ 0.29228696 \\ 0.37694224 \\ 0.1108739 \\ 0.0103766 \end{pmatrix} = 75.79$$

$$C_{\text{Xiangtan male}} = (90 \ 80 \ 70 \ 60 \ 50) \circ \begin{pmatrix} 0.231336 \\ 0.39535 \\ 0.315399 \\ 0.057931 \\ 0 \end{pmatrix} = 77.95$$

Summarize the above results, as shown in TABLE 12:

**TABLE 12 : The comparison of evaluation score**

Location	male
Guangzhou	75.79
Xiangtan	77.95

Through 12 we can see, by using fuzzy comprehensive evaluation method, the youth physical health is intuitive evaluated. Among them, Xiangtan boys have scored higher than boys in Guangzhou, that proves that the physical condition of Guangzhou boys are relatively poor than that of the Xiangtan boys. According to whether the results of statistical significance are meaningful, by the evaluation of fuzzy membership grade data method, using the method of nonparametric statistics, take the age of 15 year old boy in Guangzhou as the research object to do study.

Transmit the fuzzy judgment set into the frequency collection of fuzzy evaluation, multiple the number of boys to the proportion of fuzzy evaluation, then get the frequency collection of fuzzy evaluation Z, that is:

$$Z_{\text{Guangzhou male}} = (74 \times 0.209 \ 74 \times 0.295 \ 74 \times 0.3799 \ 74 \times 0.1131 \ 74 \times 0.0102) = (16 \ 21 \ 28 \ 8 \ 1)$$

$$Z_{\text{Xiangtan male}} = (53 \times 0.231336 \ 53 \times 0.39535 \ 53 \times 0.315299 \ 53 \times 0.057931 \ 53 \times 0) = (11 \ 21 \ 18 \ 3 \ 0)$$

Since then, take the total number of people in Guangzhou as the standard group of the research. Comply the Ridit calculation to calculate the R value. The results are shown in TABLE 13:

**TABLE 13 : Ridit calculation statistics**

(1)	(2)male	(4)=(2)+(3)	(4)/2=(5)	Cumulative number (6)	(5)+(6)=(7)	R=(7)/Total number (8)
up	16	26	13	94	107	0.8629
under	1	2	1	0	1	0.0081
average	28	43	21.5	14	35.5	0.2863
Under the average	8	12	6	2	8	0.0645
Above the average	21	37	18.5	57	75.5	0.6089

$$\begin{aligned} \bar{R}_{\text{male}} &= \sum fR / N = (1 \times 0.0081 + 8 \times 0.0645 + 28 \times 0.2863 + 21 \times 0.6089 + 16 \times 0.8629) / 74 \\ &= 0.3937 \end{aligned}$$

To make sure whether the result in the calculation above correct. This paper chose the standard error of calculate standard  $\bar{R}$  and 95% confidence interval. As shown in TABLE 14.

**TABLE 14 : The analysis table of about the standards and credibility of boys**

	$\bar{R}$	$S\bar{R} = 1/\sqrt{12N}$	$\bar{R} \pm 2S\bar{R}$
Male	0.3937	0.0335	0.326~0.460

By the detection above and combined with the fact, the results of the two areas are coincide to the fact.

## CONCLUSION

This paper established the youth physical health comprehensive evaluation system through health defect, quality, psychological, function and body shape the five indicators; and successfully applicate this system to both Guangzhou and Xiangtan. Finally, it got the result that in the health defect, Xiangtan account for the largest proportion of “upper” in the Health defect, Guangzhou accounts for the largest proportion of “lower”. In the mental health, Guangzhou accounts for the largest proportion of “upper”, Xiangtan accounts for the largest proportion of “lower”. In the physiological function, Xiangtan accounts for the largest proportion of “lower”. In body shape, Guangzhou accounts for the largest proportion of “upper” and “lower”. In the comprehensive evaluation form, Guangzhou accounts for the largest proportion of “upper”, Xiangtan accounts for the largest proportion of “lower”.

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