2014

ISSN : 0974 - 7435 Volume 10 Issue 19

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(19), 2014 [11053-11060]

Comparative study of Chinese teenagers self-physical health structure model

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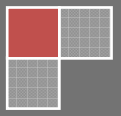
ABSTRACT

Self-physical health structure model is an advanced means and method to inspect self-physical health for adolescent. This is an advanced test method that has been improved effectively based on the original measurement of index test. In a sense, the adolescent self-physical health cognition process is fuzzy. The evaluation standard is so unclear that makes teenagers' attitudes towards physical health deviated. This results in a negative effect on the their healthy development. However, in the construction process of the model, the main point is to combine several evaluation indexes for the effective establishment of the model. Among those evaluation indexes, the cardiovascular function, cardiopulmonary function and several other physical and physiological function are included. This makes the scope of evaluation indexes extensive, at the same time; the teenagers' fitness and healthy condition can be reflected objectively and fairly. In this paper, the discriminant analysis offered a solid foundation for the model construction and does an effective analysis process for the selection of evaluation indexes. And finally, the classification model can be built more scientifically. In this way, the model built in this study could differ sharply from the traditional model. And its advantages can be fully reflected. With this model, the evaluation indexes data could be treated scientifically and studied effectively by linear functions. All this analysis provides a strong support for the study in this paper.

KEYWORDS

Teenagers; Self-physical health; Structure model; Comparative study.



INTRODUCTION

Chinese teenagers' self-physical health structure model has certain universality. It contains different species and their functional characteristics are not identical. In this paper, through the exploration of the classification model research process, its applicability and rationality could be fully reflected. In this way, the sharp contrast can be formed between classification model and the other structural ones. In this paper, the discuss will be divided into three parts as discriminant analysis, evaluation index and classification model construction. In this way, the science of research ideas could be fully shown and the study also provides a solid theoretical and data support for the further study in the future.

DISCRIMINANT METHOD

Discriminant analysis summary

Discriminant analysis is a method of multiple factor analysis. It is a method that judges the property of thing according to its nature. It is an analytical method based on the variable values of characteristics and their class to calculate the discriminant function. It classifies the unknown-class-things according to the discriminant function, which means to identify the class of unknown-property individuals and classify the individuals. In practical works, there are great needs to solve the problems of classification the individuals[1]. The general form of discriminant function is: $F = b_0 + b_1 X_1 + b_2 X_2 + ...b_n X_n$.

Here, F is the discriminant score. X is the characteristic variable of the study objects, for example, step index. b_0 is the discriminant constant, b_1, b_2,…, b_n are the discriminant coefficient. By putting the N discriminant indexes observed values of the sample into this function, the outcome value is the discriminant score of this sample.

Fisher discriminant method

There are three discriminant methods that use discriminant function to identify the sample in statistics. They are Bayes discriminant analysis, distance discriminant analysis and Fisher discriminant analysis. In this study, the discriminant model constructed by Fisher discriminant analysis is used to identify the sample. The basic points of Fisher criterion are: the differences between all kinds of average values are the biggest (even though the differences between different kinds are the greatest); sum of all kinds of internal deviation square is the minimum (even though the differences between the same kinds are the smallest). This is said that the ratio of the mean difference between class (or group) and the variance within class (or group) is the biggest, so that the geographic types can be distinguished most clearly.

EVALUATE INDEXES

Determination of indexes in the model

The determination of indexes is the key to full show the condition of teenagers' physical health. However, in this process, the chosen variable is different, the evaluate result would be different, too. During the study process in this paper, in order to make the validation process of model more scientific and more reasonable, the effective combination of national student physical health standard with teenagers' self-physical health comprehensive evaluation system to do the scientific construction is done. In the process of determination of the evaluation indexes, the height, weight, grip strength, vital capacity, standing long jump and step test are set as the basic evaluation indexes. These evaluation indexes can fully reflect teenagers' physical condition. These six discriminant indexes will all put into the model to do the effective analysis.

Analysis of chosen index

From the six indexes above, height and weight can objectively show the specific changes in the human form. And then, the change process in human skeletons and muscles can be better shown, as well as the nutritional status in the process of physical development.

In the teenagers physical quality inspection process, the vital capacity and step test are two important ways to detect effectively on students' physiological function. From these two way, the specific condition of student physiological function can be shown. Lung is the important organ for human breath and its function is to make effective use of oxygen and then to converse oxygen to carbon dioxide to expire. Through the relevant references, it can be seen that the quantity of oxygen absorbed by human has a closed link with height, weight and some other factors. For populations in different regions and different ages, their vital capacities must be studied by specific analysis. The analysis should combine with the specific sports, then, the specific differences in their vital capacities can be shown scientifically. The main problem that exists in the basic physiological function of human body can be shown, too[2]. This is proved by experiments that as vital capacity is bigger, the more quantity of oxygen is supplied to the body, so there would be a positive effect on heart and lung function. Vital capacity can reflect the basic condition of human body physiological development objectively. It is also one of objective evaluation factors of human growth and development. Step test reflects better, in a certain extent, in human motion

load bearing capacity. So it is one of the standard factors for evaluating effectively on human cardiovascular function. In the process of step test, the efficiency of cardiovascular function can be presented in a direct way. Step test, which has some same purpose as vital capacity test, is a method to test effectively the human motion load bearing capacity. The higher value it is, the more stable the human cardiovascular function is and the higher level the function is. For the group that accepts the quantitative load training, the one who often participates in exercises has a lower heart rate. So it is able to maintain the heart and lung function in a relative economical state and the recovery after quantitative load training is faster. On contrary, the one who doesn't take sport exercise often, the heart rate is higher and the recovery after training is slower. And the number of steps in the process of testing is obviously on the lower side. From this, it could be said that step test can fully shown the basic condition of the physical quality of human body[3].

From physical science research perspective, sport quality of human mainly contains human strength, speed, endurance and flexibility, etc. And the sport ability of human body mainly includes walking, running, jumping throwing and other aspects of basic movement ability. In a word, speed endurance and strength are three basic qualities for human. These basic qualities have also been identified as the fundamental sport abilities. In the evaluation process of human sports quality and sports ability, the effective evaluation is mainly in these three aspects. Among all test items, standing long jump and grip strength are the standards for evaluating objectively of human movement ability. Grip strength mainly embodies the human upper limb strength and standing long jump embodies the lower limbs strength, which also contains the coordination and explosive force. They can also show the basic status of human anaerobic metabolism and better detect the all lower limbs qualities.

Form the comprehensive exposition process above; it is shown that the importance of these six indexes for teenagers' physical quality condition. And they are also the important index for comprehensive evaluation.

CONSTRUCTION OF CLASSIFICATION MODEL

Original data processing

In the study process of this paper, youth physical quality variables and specific classification situation are dealt and analysed with cluster analysis. The specific details are shown in TABLE 1 and 2.

TABLE 1: Cluster analysis result (Boys)

Number	Height (cm)	Weight (kg)	Step index	Vital capacity(ml)	Standing long jump(cm)	Grip strength(kg)	Class
1	155.6	47.3	60	5843	208	29	1
2	158.7	55	56	4568	216	48	1
3	159	45	51	4907	217	48	1
4	159.4	60	36	4567	208	45	1
5	160	56	48	5421	218	49	1
6	172	52	48	2462	193	40	2
7	172	53	40	3015	226	36	2
8	172	53	49	1951	240	40	2
9	172	53	53	3082	215	39	2
10	172	53	55	2718	205	39	2
11	158.7	60.5	43	3895	204	42	3
12	159	48	51	4200	216	29	3
13	159	51	45	4176	241	56	3
14	159	53	42	4403	206	32	3
15	159	54	41	4402	243	43	3
16	170	58.2	51	3560	222	42	4
17	170	58.8	46	3458	233	62	4
18	170	59	46	3440	216	56	4
19	170	59	47	3084	247	59	4
20	170	59	50	3656	231	62	4

TABLE 2 : Cluster analysis result (Girls)

Number	Height (cm)	Weight (kg)	Step index	Vital capacity(ml)	Standing long jump(cm)	Grip strength(kg)	Class
1	156.8	53.5	60	4100	168	20	1
2	161	56.7	60	3604	153	20	1
3	154	48.2	41	3690	198	20	1
4	149	51.6	46	4554	136	20.3	1
5	162	52.7	42	3687	158	21	1
6	168	53	49	2145	159	22	2
7	158	50	50	1825	162	22	2
8	172	62	55	2238	163	22	2
9	162	54	49	2331	197	22	2
10	154	41.4	51	2148	207	22	2
11	156	48	45	3126	166	26	3
12	161	52.8	57	2928	169	26	3
13	157	54.2	65	3098	172	26	3
14	162	46	48	2271	173	26	3
15	166	48	43	2590	175	26	3
16	145	44	43	2471	161	23	4
17	149	45	42	2836	164	23	4
18	164	50.6	46	2437	165	23	4
19	162	49.6	43	2419	166	23	4
20	158	50	55	2428	166	23	4

From the previous discussion process, it can be seen that, before processing the teenagers' physical quality discriminant analysis, it is necessary to determine the class and relevant characteristic variable of the observed objects. This paper analyses the corresponding original data and classify the observed objects with the original data. And the method applied in this process is the cluster analysis method. In this cluster analysis method, the observed objects are classified into a group if they have something in common. There are always big differences between different groups, so the cluster analysis method is used in the classification process of observed samples[4]. The result of cluster analysis is fully presented in the TABLE 1 and 2. At the right end, there is a column named "class". From this column, the class of sample can be seen clearly.

Analysis of teenagers' physical health condition

In the discriminant analysis process of teenagers' physical health condition, the proportions of specific discriminant indexes and all kinds of discriminant indexes could be presented simple and clear. From the sample of the tables above, among 5030 male-teenagers, the first class is the one with excellent physical quality. The number of male-teenagers in the first class is 451, with a total proportion of 8.96%. The second class is the one with good physical quality. This number is 602, with a total proportion of 11.96%. The third class is the one with passable physical quality. This number is 2048, with a total proportion reached of 40.7%. The last class is the one with failed physical quality. This number is 1929, with a total proportion of 38.4%. From this data, it is obvious that the proportion of passable physical quality is the biggest. The male-teenagers in the former two classes have a better physical quality but with a less proportion, only 20.92%. This proportion is even less than the total proportion of failed physical quality class. With the same classification and analysis methods, 1064 female-teenagers have been studied. The first class is the one with excellent physical quality. The number of female-teenagers in the first class is 128, with a total proportion of 12.03%. The second class is the one with good physical quality. This number is 240, with a total proportion of 22.6%. The third class is the one with passable physical quality. This number is 374, with a total proportion reached of 35.2%. The last class is the one with failed physical quality. This number is 322, with a total proportion of 30.3%. From this data, it is able be shown that the female-teenagers with passable and failed physical quality have the bigger proportions. And the proportion of former two classes that have a better physical quality is larger than the failed one[5]. Overall, among all the 6094 teenagers, the proportion of excellent physical quality is 9.5%, of good physical quality is 13.82%, of passable physical quality is 39.7% and of failed physical quality is 36.9%.

From the process of data analysis, it is obviously that the teenagers with excellent and good physical quality are less and the most are with passable and failed physical quality while the ones with passable physical quality are more. From the data analysis, the general condition of teenager physical quality in the sample is not good. In the first and second class, the proportion of female-teenagers is greater than male-teenagers. In the third and fourth class, the proportion of male-teenagers is greater than female-teenagers. So it is fully presented that the female-teenagers have a better physical quality than male-teenagers.

TABLE 3 : Statistics of each discriminant index (Boys)

Class		Average value	Standard deviation	Number of effective sample
1	height	173.1829	5.54384	451
	weight	66.6067	10.25640	451
	step index	51.6851	7.73840	451
	vital capacity	4914.7982	330.32372	451
	standing long jump	229.0067	17.35569	451
	grip strength	48.2698	9.65704	451
2	height	168.2603	5.71443	602
	weight	57.2083	7.77474	602
	step index	50.8654	7.45436	602
	vital capacity	2685.0914	328.97978	602
	standing long jump	223.8870	16.87797	602
	grip strength	43.5179	9.33678	602
3	height	171.5823	5.48991	2048
	weight	61.8012	7.81833	2048
	step index	51.1826	7.69775	2048
	vital capacity	4171.9800	203.55628	2048
	standing long jump	227.7183	16.17495	2048
	grip strength	46.1298	9.27460	2048
4	height	169.4574	5.51313	1929
	weight	58.4850	7.14317	1929
	step index	51.3281	7.71777	1929
	vital capacity	3286.9077	206.00063	1929
	standing long jump	226.2970	16.34856	1929
	grip strength	44.4967	9.02381	1929
5	height	170.5133	5.71951	5030
	weight	60.4106	8.24375	5030
	step index	51.2455	7.68066	5030
	vital capacity	3797.9044	640.33304	5030
	standing long jump	226.8302	16.48785	5030
	grip strength	45.3828	9.31053	5030

Construction of teenagers' physical health comprehensive evaluation classification model

After processing the original data effectively, the data should be undergone a discriminant analysis. The detail of the result is shown is TABLE 5. In the TABLE 5, F1 to F3 are all the discriminant scores of samples. P1 to P4 show that the discriminant samples belong to 4 different classes, named excellent, good, passable, failed. Here, the 6^{th} line is set as an example. The sample No.6 belongs to class good. The predicted result is agreed with the practical test result. The probability is calculated effectively, and the probability P2=0.99988. This probability is so small that could be ignored. From the

prediction process of 20 samples, the prediction result and the actual test result are mostly consistent except few fault forecasts of few individual samples. The prediction result and the JI Jianye's classification result maintain a high consistent[6].

TABLE 4 : Statistics of Each discriminant index (Girls)

Class		Average value	Standard deviation	Number of effective sample
1	height	163.1016	6.56676	128
	weight	54.9289	6.75222	128
	step index	51.8828	8.77059	128
	vital capacity	3899.2578	332.90367	128
	standing long jump	180.7422	24.81308	128
	grip strength	33.4875	7.90802	128
2	height	158.7183	5.74257	240
	weight	50.4696	5.83411	240
	step index	50.6500	6.24486	240
	vital capacity	2045.3292	275.15211	240
	standing long jump	173.4042	20.84309	240
	grip strength	29.4342	7.06605	240
3	height	161.5583	5.65185	374
	weight	53.2463	6.90027	374
	step index	50.4385	7.09720	374
	vital capacity	3142.2941	194.71772	374
	standing long jump	176.8342	19.67482	374
	grip strength	30.5922	6.41323	374
4	height	159.6509	5.32701	322
	weight	51.0484	5.89194	322
	step index	50.0745	6.88992	322
	vital capacity	2650.1242	186.47081	322
	standing long jump	171.7267	16.67856	322
	grip strength	29.6416	6.30685	322
5	height	160.5261	5.87262	1064
	weight	52.1572	6.53054	1064
	step index	50.5498	7.08923	1064
	vital capacity	2836.9756	612.22184	1064
	standing long jump	174.9850	20.00103	1064
	grip strength	30.3916	6.83275	1064

The outputs of discriminant function are shown in TABLE 6 and 7. When calculate the discriminant score, the initial independent variables are used. The values of 6 evaluation indexes are directly put into the function. According to TABLE 6, the table of Fisher linear discriminant function coefficients, the 4 linear discriminant functions of determining the excellent, good, passable and failed classes for male-teenagers are:

F1=5.545X1-0.77X2+0.763X3+0.0778X4+0.01574X5+0.483X6-722.459

F2=5.555X1-0.792X2+0.768X3+0.03796X4+0.01613X5+0.476X6-570.26

F3=5.57X1-0.811X2+0.76X3+0.06462X4+0.01142X5+0.481X6-663.432

F4=5.553X1-0.819X2+0.768X3+0.005241X4+0.01107X5+0.48X6-613.636

TABLE 5 : Statistics of teenagers' physical health comprehensive evaluation classification model

Number	Actual class	Predicted class	F1	F2	F3	P1	P2	P3	P4
1	1	1	8.577	-2.578	2.867	1.000	0	0	0
2	1	1	3.218	2.256	0.570	0.57029	0	0.42964	0.00007
3	1	1	4.638	-2.166	1.594	0.98696	0	0.01304	0
4	1	1	0.243	0.052	1.108	0.59822	0	0.40173	0.00005
5	1	1	6.832	-1.008	1.82	0.99999	0	0.00001	0
6	2	2	-5.666	-0.373	-1.541	0	0.99988	0	0.00012
7	2	2	-3.303	-0.744	-1.431	0	0.70545	0.00002	0.29453
8	2	2	-7.797	-0.217	-0.967	0	1	0	0
9	2	4	-3.041	-0.696	-0.802	0	0.48840	0.00005	0.51155
10	2	2	-4.585	-0.466	-0.894	0	0.99481	0	0.00519
11	3	3	0.395	0.337	1.419	0.00014	0	0.65891	0.34094
12	3	3	1.661	-1.759	1.492	0.00688	0	0.97873	0.01439
13	3	3	1.582	-0.975	1.657	0.00657	0	0.97584	0.01760
14	3	3	2.531	-1.092	1.110	0.10795	0	0.89106	0.00098
15	3	3	2.548	00.941	1.590	0.12306	0	0.87599	0.00095
16	4	4	-1.011	-0.189	-0.134	0	0.00103	0.03514	0.96383
17	4	4	-1.431	0.262	-0.223	0	0.00498	0.01093	0.98409
18	4	4	-1.515	0.271	-0.449	0	0.00674	0.00874	0.98452
19	4	2	-3.002	0.353	-0.073	0	0.51317	0.00006	0.48677
20	4	4	-0.600	0.189	0.033	0	0.00026	0.10745	0.89229

According to TABLE 7, the physical quality of female-teenagers can be classified effectively. The discriminant functions are:

F1=5.182X1-1.119X2+0.946X3+0.05583X4+0.242X5-0.103X6-546.806

F2=5.227X1-1.09X2+0.929X3+0.0212X4+0.256X5-0.0777X6-454.898

F3=5.213X1-1.105X2+0.921X3+0.04175X4+0.246X5-0.121X6-501.748

F4=5.215X1-1.119X2+0.914X3+0.0327X4+0.241X5-0.105X6-474.46

TABLE 6 : Fisher discriminant coefficient table (Boys)

Class	1	2	3	4
height	5.545	5.555	5.570	5.553
weight	-0.77	-0.792	-0.811	-0.819
step index	0.763	0.768	0.76	0.768
vital capacity	0.0778	0.03796	0.06462	0.05242
grip strength	0.01574	0.01613	0.01142	0.01107
standing long jump	0.483	0.476	0.481	0.480
constant	-722.459	-570.26	-663.432	-613.636

After obtaining the correspondent discriminant function, for a unknown discriminant sample as $X=(X_{1i}, \ldots, X_{6i})$, it can just put these six indexes directly into the functions above. The discriminant score is marked as F. According to these branches, an effective, specific and scientific classification process could be achieved. The principle that must obey is, by comparing F scientifically, the greater values should be put in one class[7].

TABLE 7 : Fisher discriminant coefficient table (Girls)

Class	1	2	3	4
height	5.182	5.227	5.213	5.215
weight	-1.119	-1.090	-1.105	-1.119
step index	0.946	0.929	0.921	0.914
vital capacity	0.05583	0.0212	0.04175	0.0327
grip strength	0.242	0.256	0.246	0.241
standing long jump	-0.103	-0.0777	0.121	-105
constant	-546.806	-454.898	-501.748	-474.46

CONCLUSION

This paper aims at the comparative study of Chinese teenagers' self-physical health model. The two important points in the study are comprehensive evaluation indexes and construction of classification model. And the advantages of this model are also presented in these two aspects. In this way, the study gets more persuaded and the study ideas presents much clearer and more pertinent. So the final purpose could be reached.

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