

Research on the Index System of Specific Physical Fitness of College Women's 5000m Athletes in Hebei Province

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Abstract—This article commences from the point of view of physical training, it determines the typical specific physical fitness index which affects Hebei Province's College Women's 5000m athletes' athletic performance through the integrated use of literature, survey method, factor analysis, gray correlation analysis, regression analysis, logical analysis. And it establishes the special performance prediction model and the evaluation and diagnostic criteria of specific physical fitness for the College Women's 5000m athletes in Hebei Province.

Keywords- Hebei Province; colleges and universities; women's 5000m; special physical fitness

I. INTRODUCTION

Main factors that influence the grades of long-distance athletes include: shape and function, specific techniques, specific physiques. Shape and function apply the fundamental influence to the specific grades, the specific physiques and specific techniques; specific physiques apply the direct improvement on specific training; specific physiques and specific techniques apply the final effect on specific grades. The experts and scholars in our country did numerous researches and studies on women's long-distance running and receive some results. However, it is apparently unwise if we put study results gained from high-level athletes and competitions into the regular universities and colleges or low-level matches' training and practice. Therefore, based on physical training this essay will discuss female 5000-meter athletes' specific physical indexes in the regular universities and colleges of Hebei Province, the contributions of these indexes on athletes' grades, the interrelationship and proportional development of each index etc.

II. STUDY OBJECTS AND METHODS

A. Study objects

The study object of this essay is specific physical fitness of female long-distance athletes in the regular universities and colleges of Hebei Province, and we select 20 female athletes of 5000-meter running from regular universities and colleges, total 20 sets of data. (See Table I)

TABLE I. THE BASIC SITUATION OF THE OBJECT OF STUDY

Number	Age	Results
20	20.42 ± 1.25	$20:49.55 \pm 1:27.85$

B. Study methods

1) *Survey*: In order to ensure the specific physical indexes of female long-distance athletes to be scientific, reasonable and accurate, surveys' objects consist of teachers of sports teaching major and women's long-distance training in the province, relevant professors with titles higher than associate professor as well as teachers of women's long-distance training and studying with titles higher than senior teacher, total 20 persons.

2) *Mathematical statistics*: Collect the gathered survey data and information, then enter them into EXCEL data base and use the EXCEL and SPSS 13.0 to process and analyze the collected data, and obtain the approval of theoretic and logic support. Apply the grey collation analysis on data to obtain the percentages of each index of female long-distance athletes, and rank them based on the values of percentages. Apply factor analysis on index factors, filter and determine the independent variable. Use the regression analysis to set multi-factors regression equations, and set predictive model of evaluating specific physical grades. Use principle of normal distribution to establish the centesimal evaluation forum and standard.

III. RESULTS AND ANALYSIS

A. Main factors that influence the grades of female long-distance athletes from regular universities and colleges in the province

Based on the professors' survey indexes and coaches' practical indexes, we finally set the specific physical indexes of 5000-meter athletes to 100m, 200m, 400m, 600m, 800m, 1000m, 2000m, 3000m, 4000m, 5000m, 6000m, 8000m, 10km, 12km, total 14 indexes.

B. Mathematical statistics on female athletes' specific physical indexes of 5000-meter running

According to the principles of statistics, we use factors analysis to determine the representative indexes from specific physical indexes, which influence the grades of women's 5000-meter running in the province.

Firstly, use KMO test and Bartlett test on the data to determine whether use factor analysis or not. From the Bartlett test, the F value equals 0.000, which means the data comes from the whole normal distribution; the KMO value is 0.752, which means the availability of factor analysis. (See Table II)

TABLE II. KMO AND BARTLETT'S TEST

KMO	Bartlett		
	X ²	df	F
0.752	895.957	91	0.000

Then, apply Kaiser Standard Equamax, and obtain the rotated factor load matrix (See Table III). Find the coefficient of common factors before rotation. After the rotation, the value selection of factor load coefficient is more critical, and practical iterative time is 4. Therefore, the number of factor extraction is 4. At last, accomplish the factor analysis of indexes.

TABLE III. ROTATED COMPONENT MATRIX

	component						
	1	2	3	4	5	6	9-14
VAR12	0.911	0.24	0.221	0.231	0.032	0.019	.....
VAR08	0.91	0.294	0.188	0.193	-0.023	-0.003	.....
VAR13	0.90	0.289	0.218	0.187	-0.053	0.029	.....
VAR07	0.89	0.327	0.226	0.2	0.016	0.009	.....
VAR11	0.882	0.294	0.175	0.218	0.236	0.01	.....
VAR14	0.876	0.252	0.232	0.286	0.142	-0.027	.....
VAR09	0.859	0.324	0.203	0.265	0.171	0.051	.....
VAR10	0.814	0.333	0.121	0.195	0.418	0.002	.....
VAR06	0.784	0.42	0.349	0.207	0.167	0.049	.....
VAR05	0.76	0.469	0.377	0.16	0.022	0.182	.....
VAR04	0.704	0.515	0.427	0.2	0.029	0.128	.....
VAR01	0.261	0.939	0.132	0.167	0.068	0.007	.....
VAR03	0.419	0.603	0.605	0.294	0.079	-0.036	.....
VAR02	0.502	0.489	0.234	0.669	0.076	0.018	.....

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.a Rotation converged in 6 iterations.

C. Determination of specific physical representative indexes of 5000-meter

With steps above, we select 4 factors to set up factor-load, and analyze the indexes of 5000-meter, then obtain

factor load matrix in Table IV. From the value of variance after rotation, the Eigen value of the 4 factors is greater than 0.713, and the variance ratio is 98.073%, which proves that these 4 factors include the information from the 14 original indexes. So we select 4 representative indexes: A12-8000 meters, A7-2000 meters, A3-300 meters, and A5-800 meters. Therefore, from factor analysis, we obtain the indexes that influence the grades of 5000-meter athletes are 400 meters, 800 meters, 2000meters and 8000 meters.

TABLE IV. ROTATED COMPONENT MATRIX

	Component			
	1	2	3	4
A 12	0.914	0.287	0.232	0.12
A 11	0.908	0.34	0.226	-0.066
A 8	0.904	0.327	0.179	0.122
A 13	0.894	0.328	0.174	0.179
A 14	0.892	0.308	0.308	0.028
A 9	0.892	0.373	0.192	0.116
A 10	0.88	0.376	0.269	-0.015
A 6	0.859	0.374	0.209	-0.24
A 1	0.814	0.51	0.223	0.082
A 2	0.777	0.559	0.155	0.215
A 4	0.722	0.615	0.207	0.225
A 7	0.26	0.941	0.115	-0.1
A 3	0.511	0.55	0.649	0.02
A 5	0.45	0.75	0.351	0.257

TABLE V. TOTAL VARIANCE EXPLAINED

Component	Rotation Sums of Squared Loadings	
	Total	Cumulative %
1	8.516	62.117
2	3.527	88.025
3	1.09	95.807
4	0.713	98.073

D. Set predicative model for specific grades of female 5000-meter athletes in the province

In order to build easier evaluation for coaches on athletes' specific physical fitness, we set up the predicative model of female long-distance athletes in the province, and coaches could use the model to predict the grades. Use stepwise regression to collect, then remove the irrelevant indexes for grades, and set the predicative model of female 5000-meter athletes' specific grades (See Table VI).

TABLE VI. PERFORMANCE PREDICTION MODEL

model	R	R ²	F	P
Y=386 (s) +1.67*2000m (s)	0.908	0.824	84.05	0.000

In Table VI, the R value of the regression equation equals 0.908, which means it is highly relevant to dependent variables in calculation of regression equation. Coefficient value R²=0.824, which means the selected variables could reflex the 82.4% information of aggregate variable. The statistics value F is 84.05, and P value is 0.000, so the selected result is ideal.

E. Evaluation and diagnosis of female long-distance athletes' specific physical indexes in the province

1) Individual index evaluation standard of female long-distance athletes' specific physical fitness. This study use centesimal method on evaluation of specific grades Y and 4 selected indexes, then calculate each individual evaluation, and obtain the evaluation standard of 5000-meter grade Y and 4 selected indexes (See Table VII). Coaches could search the grades gained from evaluation forum and then estimate on female long-distance athletes' various indexes, position, and level.

TABLE VII. EVALUATION OF THE PHYSICAL QUALITY INDEX OF SPECIAL TABLE

value	5000m (s)	400m (s)	800m (s)	2000m (s)	8000m (s)
100	999.62	60.52	135.11	377.62	1652.85
99	1004.22	60.73	135.85	380.10	1663.49
98	1008.83	60.94	136.58	382.59	1674.13
97	1013.43	61.15	137.32	385.08	1684.78
...

2) Evaluation methods and standard of representative specific physical indexes. Step 1; calculate the weight coefficient of each index. (See Table VIII)

TABLE VIII. GREY CORRELATION DEGREE ANALYSIS

	400m	800m	2000m	8000m
Grey correlation degree	0.99	0.98	1.00	1.02
weight (%)	24.74	24.61	25.12	25.53

Step 2; find out the individual score and weight coefficient of each index by Table VII and VIII.

TABLE IX. SPECIAL PHYSICAL QUALITY COMPREHENSIVE EVALUATION OF DEVELOPMENT LEVEL

Evaluation grade	standard
Top	Y>65.99
Middle	34.23 (42) ≤Y≤65.99
Inferior	Y<34.23

Step 3; use equation $Y=X_1 \times Z_1 + X_2 \times Z_2 + X_3 \times Z_3 + X_4 \times Z_4$, then calculate the total score of athletes' index and obtain the mean value and standard deviation of Y value. X 1, X 2, X 3, X 4 is the individual score of each index, and Z 1, Z 2, Z 3, Z 4 is the weight coefficient of athletes' each index. Y is the total development score of the athletes' indexes.

According to the principle of normal distribution, calculate and obtain the evaluation forum of the athletes' indexes. From Table IX, 5000-meter athletes score with 34.23-65.99 is the average level, above 65.99 is high level, and fewer than 34.23 is low level.

3) The determining and standard for the compatibility of specific physical index development and specific grades. According to the standard average score from III.E.2), and find the differentials from Table VII, we could accurately find out the compatibility between two of them. Calculate with the data of 5000-meter athletes, then find the differentials and calculate mean value, standard deviation, and at last check on compatibility by principle of normal distribution. (See Table X)

TABLE X. DEVELOPMENT LEVEL OF PHYSICAL ABILITIES AND SPECIFIC PERFORMANCE EVALUATION CRITERION OF FITNESS

Evaluation class	Evaluation criteria
Comprehensive development level of physical fitness and specific performance adaptation	-5≤C≤5
Comprehensive development of physical quality level higher than the specific performance adaptation	6≤C≤10
Development of physical abilities levels below specific performance basic adaptation	-10≤C≤-6
Development of physical abilities levels significantly higher score not adapted	C>11
Development of physical abilities levels significantly lower than failing to conform to specific performance	C<-11

IV. CONCLUSIONS AND SUGGESTION

A. Conclusions

- Determine the indexes that influence the grades of female 5000-meter athletes are 400 meters, 800 meters, 2000 meters and 8000 meters.
- According the representative specific physical indexes, set up the predicative model of female long-distance athletes in the province, which is $Y(5000m) = 386(s) + 1.67 * 2000m(s)$.
- Establish the indexes and evaluation standard of female 5000-meter athletes in the province, which includes the individual evaluation standard of 5000-meter athletes, evaluation methods and standard of specific physical indexes, compatibility between specific physical index development and specific grades.

B. Suggestions

- The purpose of this study is to provide the female 5000-meter athletes in regular universities and colleges with scientific protection. The evaluation and diagnosis standard of 5000-meter athletes are scientific and reliable based on research methods, index system, and evaluation system. In order to make it to be functional and improving, we expect all the athletes and coaches could apply it in the practical training.

- This essay mainly studies on the specific physical fitness of women's 5000-meter in the province. In order to make the training increasingly scientific, it will be wise to not ignore other factors in the training. Therefore, it will be necessary for coaches to combine with other rational methods in the training while using the evaluation and diagnosis standards, so as to gain the maximum appropriate training benefits with scientific management.

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