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Factor analysis-based Chinese universities aerobics sustainable development research

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ABSTRACT

Competitive sports competitions' aerobics motions are elegant and artistic, and well received by national people; it has been rapidly developed and gradually popularized in Chinese universities campuses. Targeted at Chinese universities aerobics development factor "University students in school satisfaction with universities aerobics development", "Aerobics athletes training times", "Aerobics athletes duration per one training", "Aerobics athletes' age", "Aerobics coaches' age", "Aerobics coaches' education background", it makes factor analysis and gets aerobics development mainly rely on aerobics coaches and aerobics athletes themselves such two factors. Only the two are well mutually adjusted then can let Chinese aerobics to be better developed.

KEYWORDS

Factor analysis; Statistical analysis; Aerobics; Physiological indicator; Competitive sports.

INTRODUCTION

In competitive sports games, aerobics is introduced to China in 80s of 20th century, due to aerobics motions are elegant and artistic, is well received by national people, it has been rapidly developed and gradually popularized in Chinese universities campuses. By far, aerobics has already become an important part in Chinese some universities campus cultures. In recent years, with competitive sports development and university sports constantly infusion, let Chinese some universities competitive aerobics to arrive at international advanced level, many universities delegations performances are outstanding, they have achieved excellent results in many international big sports events.

These proud performances achievement is from Chinese universities competitive sports development and university students' constant efforts, it reserves lots of excellent reserve talents for Chinese competitive aerobics team, with respect to this, and we summarize Chinese universities competitive sports stage development objective, its result is as TABLE 1.

TABLE 1 : Chinese universities competitive sports stage development objective

Objective time limit (years)	Objective contents	Planning objectives
2001——2003	On the basis of full investigation, identify and analyze Chinese universities competitive sports development decisive main factors, construct Chinese universities competitive sports development objective system.	Construct new period universities competitive sports development objectives to adapt to socialism market economy system, carry on system and mechanism reformation, establish new competitive system that is fit for new objectives, let Chinese universities competitive sports each aspect level to be promoted. Perfect Chinese universities competitive sports each institutions, form into universities competitive sports competition system with Chinese characteristics, let Chinese universities competitive sports level overall to be promoted, and be able to meet demands of education, sports, social each aspect on university competitive sports.
2004——2005	Under new objective system, make comprehensive reorganization and reconstruction on Chinese universities competitive sports, preliminarily form a set of new operation system	
2006——2008	Continue to expand Chinese universities competitive sports scale, form multiple hierarchies, multiple grades competition system, gradually expand Chinese university competitive sports market range, and enhance commercialization and socialization levels.	
2009——2010	Chinese universities competitive sports competition, scale, market, regulations basically form, and sports level corresponding improves, and form into good momentum of sustainable development.	

Along with Chinese competitive sports system reformation constantly development and deepening, competitive sports and universities aerobics team organic combine that lets China's implementation of national fitness, national sports to be well carried on. With respect to this, we carry on factor analysis of Chinese universities aerobics status.

EVALUATION MODEL ESTABLISHMENTS

Main way of factor analysis is reducing dimension of variables, which is recombining original many variables with correlation into a group of uncorrelated variables to replace original variables and use as one factor. Therefore, we can pay attention to every time observation's variables that have maximum variation, to every time observation's small changed variables that can be used as constant to process and get rid of them, so that it reduces variables number in problem that needs to be considered.

Assume that there is m pieces of original indicators to do factor analysis, which are recorded as $x_1, x_2, \cdots, x_m$, now it has n pieces of samples, corresponding observation value is $x_{ik}(i = 1,2,\cdots,n)$, and $k = 1,2,\cdots,m$ takes standardization transformation, and then transform x_k into x_k^*, that:

$$\mathbf{x_k^* = \frac{x_k - \overline{x_k}}{s_k},\ k = 1,2,\cdots,m} \quad \textbf{(1)}$$

Among them, $\overline{x_k}$ and s_k are respectively x_k average number and standard deviation, x_k^* average number is 0, standard deviation is 1.

According to each sample original indicator observation value x_{ik} or after standardization observation value x_{ik}^*, it solves coefficient b_{kj}, establish indicator x_k^* that is transformed through standardization to express comprehensive indicator z_j equation $z_j = \sum_k b_{kj} x_k^*$, which can also establish equation that uses original indicator x_k to express comprehensive indicator z_j :

$$\mathbf{z_j = \sum_k \tilde{b}_{kj}\, x_k^* + a_j} \quad \textbf{(2)}$$

There are two requirements on defining b_{kj} :

Comprehensive indicators are mutual independent from each other or uncorrelated.

Every comprehensive indicator reflected each sample gross information content is equal to corresponding feature vector (comprehensive indicator coefficient)feature values. In general, it is required that selected comprehensive indicator feature vales contribution ratios sum to be above 80%.

Factor analysis general steps

(1) According to observed data, calculate $\overline{x_k}$ and $s_k\left(k,\ j = 1,2,\cdots,m\right)$.

(2) By correlation coefficient matrix R, it can get feature value $\lambda_j\ \left(j = 1,2,\cdots,m\right)$ and each factor variance contribution contribution ratio and accumulative contribution ratio, and define factor reserved number p with accumulative contribution ratio as evidence.

m pieces of basic equations are as following:

$$\begin{cases} \mathbf{r_{11}x_1^{(j)} + r_{12}x_2^{(j)} + \cdots + r_{1m}x_m^{(j)} = \lambda_j x_1^{(j)}} \\ \mathbf{r_{21}x_1^{(j)} + r_{22}x_2^{(j)} + \cdots + r_{2m}x_m^{(j)} = \lambda_j x_2^{(j)}} \\ \cdots \\ \mathbf{r_{m1}x_1^{(j)} + r_{m2}x_2^{(j)} + \cdots + r_{mm}x_m^{(j)} = \lambda_j x_m^{(j)}} \end{cases} \quad \textbf{(3)}$$

Among them, $j = 1,2,\cdots,m$.

Proceed with Schmidt orthogonalization, for every λ_i, solve its basic equations solution $x_1^{(j)}$, $x_2^{(j)}$, …, $x_m^{(j)}\ \left(j = 1,2,\cdots,m\right)$, and then let:

$$\mathbf{b_{kj} = \frac{x_k^{(j)}}{\sqrt{\sum_k \left(x_k^{(j)}\right)^2}}} \quad \textbf{(4)}$$

It can get x_1^*, x_2^*, …, x_m^* expressed factor $z_j = \sum_k b_{kj} x_k^*$, or input $x_k^* = \frac{x_k - \overline{x_k}}{s_k}$ and then get x_1, x_2, …, x_m expressed factor $z_j = \sum_k \tilde{b}_{kj}\, x_k^* + a_j$.

(4) Input x_1, x_2, …, x_m observed values into factor expressions, calculate each component value.

Calculate original indicator and factor correlation coefficient that is also factor loading that use it to explain factor significances. And go ahead with next step model establishments' analysis.

Correlation indicator each factor analysis

Here, we discuss from 40 universities aerobics universities students satisfaction, coaches' age structure, athletes techniques grades, athletes ages, fields' facilities status, school funding for aerobics, coaches' education background and titles, athletes sports training years, training results testing factors, training motivations, training times and temporal distribution. Forty universities that are taken questionnaire survey, their names are as TABLE 2.

TABLE 2 : Research objects sampling universities name list

No.	School	No.	School	No.	School
1	Tsinghua University	15	Northwest University	28	Zhejiang University of Technology
2	Peking University	16	Xi'an Jiao tong University	29	Beijing University of Posts and Telecommunications
3	Beijing Institute of Technology	17	Northwestern Industrial University	30	Jiangsu University
4	Beihang University	18	Chang'an University	31	China University of Mining and Technology
5	University of Science and Technology Beijing	19	Qufu Normal University	32	Huazhong University of Science and Technology
6	Jilin University	20	Shandong Normal University	33	Wuhan University of Technology
7	Northeast Normal University	21	Yan'tai Normal College	34	Taiyuan Normal College
8	Henan Normal University	22	Southwest Jiaotong Institute	35	Taiyuan University of Technology
9	Zhengzhou University	23	Sichuan Unite University	36	Shan'xi Normal University
10	Henan University	24	Hunan Normal University	37	Guangxi Normal College
11	Zhengzhou Aviation University	25	Changsha University of electronic power	38	Normal College of South China
12	Shanghai University of Chinese Medicine	26	Hunan Central South University	39	Guangzhou Zhongshan University
13	Xi'an Petroleum Institute	27	Hunan National University of Defense Technology	40	Shantou University
14	Xi'an University of Technology				

(Data source: Liu Hai-Yuan etc. questionnaire survey in "Chinese universities competitive sports development research")

For universities aerobics satisfaction, we make statistics; the statistical result is as following TABLE 3.

TABLE 3 : University students' satisfaction on universities aerobics

Satisfaction	Selection number of people	Percentage
Great satisfaction	186	37.21%
More satisfactory	174	34.88 %
Yawp	93	18.60 %
Very dissatisfied	47	9.30 %

Correspond to above data; it makes "black-white pie chart" as Figure 1.

Correspond to above analysis, we can get conclusion as following : On a whole, present Chinese universities students are mostly satisfied with universities aerobics team that occupy 37.21%(Great satisfaction)of totality, 34.88%(More satisfactory)of totality.

For universities aerobics coaches' age structure, it makes analysis. Statistical result is as TABLE 4.

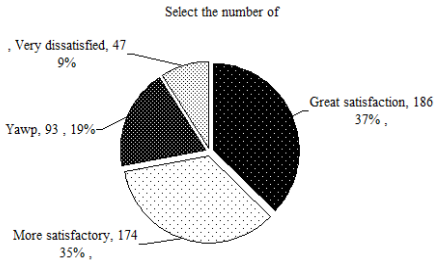

Figure 1 : College students in colleges and universities aerobics satisfaction

TABLE 4 : Universities competitive aerobics sports team coaches' age distribution

Age structure	Number of people	Proportion
21-30	7	31.82%
31-35	11	50%
36-45	3	13.64%
46-55	1	4.54%
Above 56 years old	0	0.00%

Correspond to above data; it draws "black-white bar chart" as Figure 2 shows.

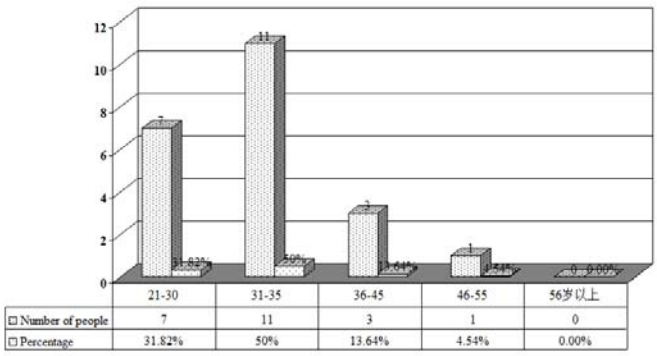

Figure 2 : Sports team coaches' age distribution of sports aerobics dancers in college

From above analysis, it is clear that universities aerobics coaches' age distribution are mostly in 31 to 35 years old that occupy half of totality, while no old coaches that are above 56 years old.

Then make analysis of universities aerobics athletes' training times and duration, statistical result is as TABLE 5.

Correspond to above data; it draws "black-white bar chart" as Figure 3, 4.

By above analysis, we can see that universities aerobics athletes training duration concentrates in three to four times a week, and every time training duration concentrates on every one to two hours that respectively occupy 44.00% and 56.80% of totality.

For aerobics players' age structure, it makes analysis. Its statistical result is as TABLE 6.

Correspond to above data, it makes pie chart as Figure5.

From above analysis, it is clear that aerobics players' age distribution concentrates on 22 years old that occupy 36.8% of totality.

Finally targeted at coaches' education background, titles status, it makes analysis; its statistical result is as TABLE 7.

Correspond to above data, it makes "Two axes bar chart" as Figure6.

TABLE 5 : Universities aerobics athletes' training times and duration analysis statistical result

Training times and duration	Number of people	Proportion
Twice per week and below	38	30.40%
Third to four times per week	55	44%
Five to six times per week	18	14.10%
Seven to eight times per week	9	7.20%
Above nine times per week	5	4%
Sum total	125	100.00%
Every one hour at a time	29	23.20%
Every one to two hours	71	56.80%
Every two to three hours	14	11.20%
Every three to four hours	7	5.60%
More than four hours at a time	4	3.20%
Sum total	125	100.00%

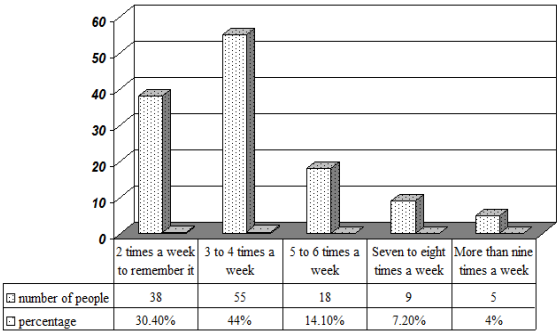

Figure 3 : The number of colleges and universities aerobics athlete training

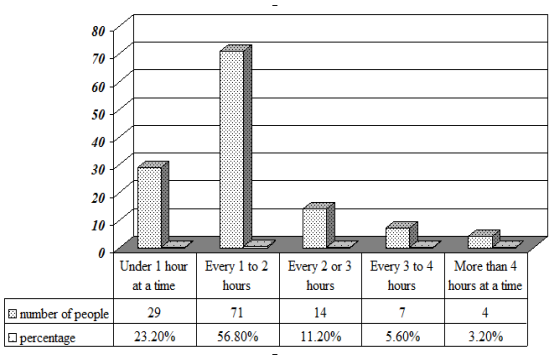

Figure 4 : Colleges and universities aerobics athlete training time

TABLE 6 : Universities aerobics team players' age distribution

Age structure	Number of people	Percentage
Below 20 years old	22	17.60%
21 years old	35	28%
22years old	46	36.80%
23years old	14	11.20%
Above 24years old	8	6.40%

By above analysis, it is clear that aerobics coaches education background is mostly master that occupies 72.27% of totality, and aerobics coaches' titles are mostly lectures that occupy 72.27% of totality.

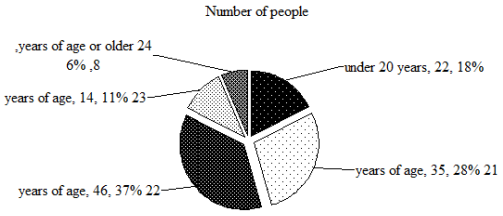

Figure 5 : The age distribution of colleges and universities aerobics sports teams players

TABLE 7: Aerobics coaches' education background, titles distribution status

Education background status	Number of people	Percentage	Titles status	Number of people	Percentage
Junior college	0	0	Assistant	4	18.18%
Undergraduate course	5	22.73%	Lecturer	16	72.27%
Master	17	72.27%	Associate professor	1	4.55%
Doctor	0	0	Professor	1	4.55%

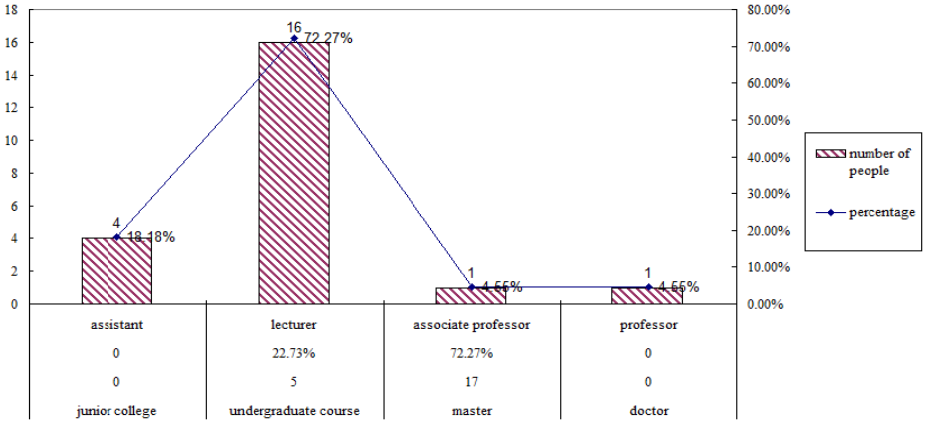

Figure 6 : Aerobics degree distribution, the title of the coaches

Result analysis

By above each factor statistical analysis, and then carry on analysis of universities students in school satisfaction on universities aerobics development, aerobics athletes training times, aerobics event duration per one time training, aerobics athletes' age, aerobics coaches age, coaches' education background, and get their " factor scree plot" as Figure 7.

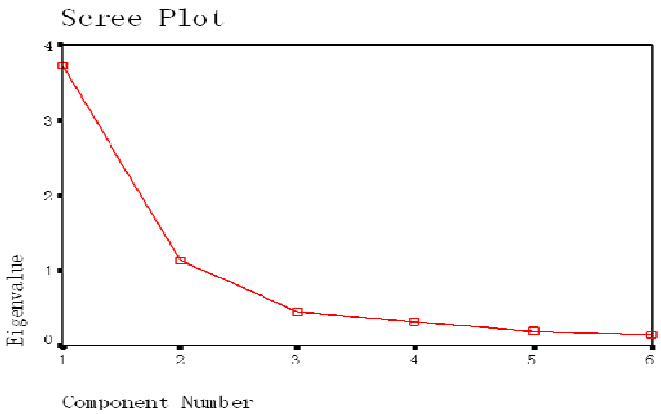

Figure 7 : Factor of gravel figure

By above factor analysis, it can get that ‘universities students in school satisfaction on universities aerobics development’, ‘aerobics athletes training times’, ‘aerobics event duration per one time training’, ‘aerobics athletes’ age’, ‘aerobics coaches age’, ‘coaches’ education background’; these factors can be summarized into two main factors (because there are two larger slope changes in scree plot), one factor is from aerobics coaches, the other is from aerobics athletes own factor.

CONCLUSION

Chinese universities competitive sports development has gone through some setbacks, here summarize Chinese universities relative competitive sports reformation and structural adjustment changing status as TABLE 8.

In Chinese universities, aerobics takes advantages of national policies reformation and self charm to get well development in Chinese universities. The paper carries on factor analysis of Chinese universities aerobics team development influence factors and gets aerobics development mainly relies on aerobics coaches and aerobics athletes themselves two factors. Only do well in mutual adjusting of the two then can move Chinese aerobics to next level.

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