ISSN : 0974 - 7435 Volume 10 Issue 7

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(7), 2014 [2184-2191]

Research on analytic hierarchy process-based sports events impacts on university students' psychological health

Ning Guo[1]*, Yan He[2], Xiusheng Guo[3]

[1]Physical Education Department of Huazhong Agriculture University, Wuhan, 430070, Hubei, (CHINA)

[2]Huazhong University of Science and Technology at Branch Wuhan, Wuhan 430064, Hubei, (CHINA)

[3]Police Training Center of Heilongjiang Provincial Public Security Department, Heilongjiang, (CHINA)

ABSTRACT

In the information age of today, computer, mobile phone and other electronics devices have become important parts in university students' recreational entertainment. Due to lack of physical exercises for a long time, university students' body and psychology appear serious problems. As far as university students concerned, physical exercise is the best way to enhance physical functions. The paper takes university students as research objects, starts from psychology influential ten factors, utilize principal component analysis method to reduce ten factors into four factors. Regard swimming, running, basketball and table tennis as research objects, utilize analytic hierarchy process, construct target layer judgment matrix and criterion layer judgment matrix, according to Matlab program operating results, it judges that the biggest influential effective sports event on university students' psychology-basketball, the result conforms to practical situation.

KEYWORDS

Sports psychology; Principal component analysis; Analytic hierarchy process; Psychological health; Judgment matrix.

INTRODUCTION

With employment pressure constantly increasing, university students' psychological problems have become focus of social concerns. To university students, best sports way to solve psychological problems is physical exercise.

In 2010, Shi Wen-Yan in the article "university students participate in physical exercises and psychological health relations research", took university students' psychological health as starting point of researches, applied on-line searching and other researching methods, studied physical exercises and psychological health relationships from the perspective of sports, psychology and social. The research showed physical exercise had certain correlations with psychological health, and meanwhile author pointed out different physical exercise items had significant differences on psychological health problems' influences. In 2012, Lin Sheng-Tong in the article "Dialyze psychological warfare influence on athlete competition result from sports media and application" explained athlete psychological control ability affecting competition results from the perspective of sports media. The paper comprehensive applied multiple research methods, analyzed sports media influences on athletes' competition results. Result showed that in table tennis and other single competitions and basketball, football team competitions, media effects on psychology had seriously impacted on competition results, each coach and athlete should apply the theory into practice. In 2013, Dong Xiong in the article "Sports curriculum setting to students' physical health status influence factors analysis and countermeasures research ---take Taiyuan junior high school stage's students as examples", comprehensive applied multiple investigation methods and research methods, analyzed Taiyuan junior high school students physical status, analysis results showed that Taiyuan junior high school students' body shape overall development was good but endurance quality development was not stable, while urban and rural students' development status had certain differences. In 2008, Zhou Jian-Xin in the article "Sports optional courses teaching to university students psychological health influences research" applied psychological investigation method and others multiple research methods, took university students as experiment objects, analyzed experiment results, results showed sports optional course was more beneficial to students' psychological health than traditional sports teaching. Ball type and rhythmic gymnastics type optional courses could propel to university students' psychological health development, but they had different impact degrees on university students' psychological health. In martial arts teaching process, reasonable implemented psychological interference could let university students' psychology to get more healthy development.

By referencing lots of documents, the paper targeted at swimming, running, basketball, and table tennis four sports events, researches on their relations with university students' psychological status.

ANALYTIC HIERARCHY PROCESS MODEL AND DATA PROCESSING

University students' psychological problems contain somatization, obsession, interpersonal relationships, depression, anxiety, hostility, terror, paranoid, psychoticism, sleep and diet ten specific problems. The paper selects sports events representative and universal four sports events swimming, running, basketball and table tennis as relational terms.

Original data

In TABLE 1, TABLE 2 original data is from the article "university students' participation in physical exercises and psychological health relations research".

From TABLE 1, TABLE 2, we can see there are totally ten influence factors. Make principal component analysis of TABLE 1 data, analysis result is as Figure 1 shows.

From Figure 1, we can see that variable 8, variable 1, variable 9 and variable 3 are main variables. So, we regard ten psychological factors somatization, interpersonal relationships, terror, and paranoid as factors in criterion layer.

TABLE 1 : Each sport event score

	Swimming	Running	Basketball	Table tennis
Somatization	1.24	1.33	1.34	1.29
Obsession	1.37	1.41	1.52	1.39
Interpersonal relationship	1.44	1.47	1.32	1.39
Depression	1.45	1.51	1.53	1.49
Anxiety	1.31	1.4	1.43	1.42
Hostility	1.49	1.51	1.61	1.54
Terror	1.21	1.29	1.3	1.27
Paranoid	1.41	1.42	1.48	1.5
Psychotism	1.24	1.29	1.28	1.26
Sleep and diet	1.24	1.22	1.21	1.23

TABLE 2 : Different exercises levels psychological factors comparison chart

	Often exercise	Rarely exercise
Somatization	1.32	1.45
Obsession	1.52	1.64
Interpersonal relationship	1.43	1.57
Depression	1.46	1.56
Anxiety	1.39	1.49
Hostility	1.53	1.47
Terror	1.25	1.28
Paranoid	1.44	1.49
Psychotism	1.26	1.29
Sleep and diet	1.23	1.37

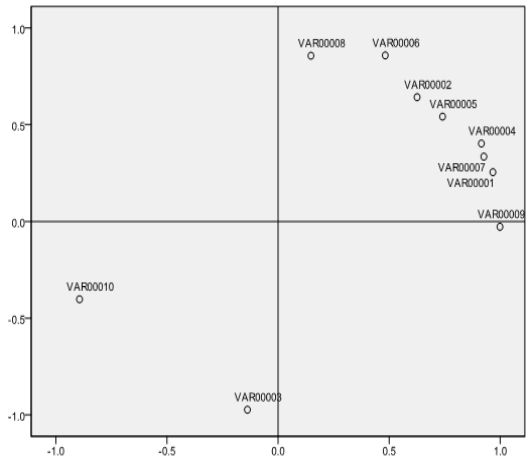

Figure 1 : The results in figure

AHP principles

AHP can solve relative tedious and vague problems' decision-making problems. Use the method to construct model, it roughly needs four steps :

- Establish hierarchical structure scheme;
- Construct every layer that fully used in judgment matrix;
- Hierarchical single arrangement and consistency test;
- Hierarchical total arrangement and consistency test;

In the following, it respectively states each step detailed process.

AHP solved problems are required to be hierarchic, orderly and logic. Only then it can construct hierarchical scheme. Let tedious problems' elements to form into multiple hierarchies according to its attributes, membership and its relations. Last hierarchical element plays a dominate role in next hierarchical relative elements. In general, these hierarchies can be divided into 3 types:

(1) Top layer: Only one element in this hierarchy, it normally is final target of analytic problems. The layer is also called target hierarchy.

(2) Middle hierarchy: In this hierarchy, it includes intermediate links that get involved to fulfill targets, which can be composed of some hierarchies that include multiple and multilayer criterions that required to consider. It can also be called criterion hierarchy.

(3) The bottom hierarchy: This hierarchy includes optional each method and way to fulfill targets. It can also be called measure hierarchy or scheme hierarchy.

Hierarchy numbers in hierarchical structure have something to do with problem's complicated degree as well as analysis detailed requirements, normally the hierarchy numbers are not limited, each element in every hierarchy governs less than 9 elements. Hierarchical structure is as Figure 2.

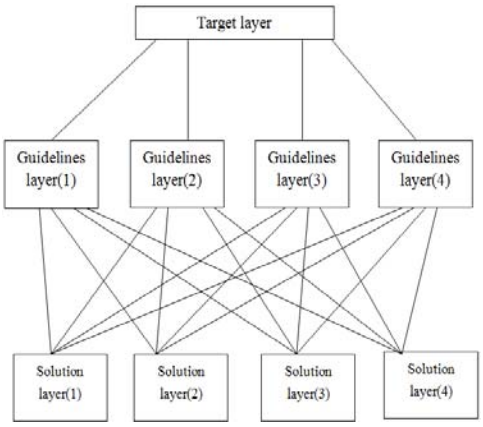

Figure 2 : Hierarchical structure chart

In Figure 2, layer 1 is target layer that is the purpose which is required to finally fulfill for researching problems, layer 2 is criterion layer that is the medium process that researching problems go through, layer 3 is scheme layer that is each kind of referencing schemes. In general, layer one is one factor, layer two and layer three have multiple factors and quantity is not fixed.

Each layer structure can show factors relationships, but in middle layer, each factor occupied proportion in target evaluation basically will not be fully the same, in the heart of evaluators, each factor has certain proportions.

When define each factor proportion that is to compare n pieces of factors $X=\{x_1,\cdots,x_n\}$ to factor Z impacts. *Saaty* and others proposed to carry out paired comparison among factors, and constructed comparison matrix method. That is to say, it selects two factors x_i and x_j every time, uses a_{ij} to express x_i and x_j to Z impacts ratios, all comparison is using matrix $A=(a_{ij})_{n\times n}$ to express, A has become judgment matrix between $Z-X$. From matrix, it is clear that if x_i and x_j to Z impact ratio is a_{ij}, then x_j and x_i to Z impact ratio is $a_{ji}=\frac{1}{a_{ij}}$.

According to linear algebra theoretical knowledge, if matrix $A=(a_{ij})_{n\times n}$ meets $a_{ij}>0$ and $a_{ji}=\frac{1}{a_{ij}}(i,j=1,2,\cdots,n)$, then matrix A is positive reciprocal matrix.

a_{ij} Value determination can accord scale table, contents are as following TABLE 3.

TABLE 3 : Scale table

Scale	Definition
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is obviously more important than the later by comparing two factors
7	Indicates the former is intensely more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
2, 4, 6, 8	Indicates middle level of above judgment
Reciprocal	If importance ratio between i and j is a_{ij}, then importance ratio between j and i is $a_{ji} = \frac{1}{a_{ij}}$.

Consistency test

Matrix A corresponding maximum feature value $\lambda_{\max}$ feature vector W, it is the priority weight of same hierarchy corresponding elements relative importance to last hierarchy some element through normalization, the process is called hierarchical single arrangement. Though the process can reduce other factors interference, it is hard to avoid appearing inconsistency to some extent when integrate all comparison results. If comparison results are consistent, then A factor should also meet:

$$\mathbf{a_{ij}a_{jk} = a_{ik}, \forall i, j, k = 1,2,\cdots, n} \quad \textbf{(1)}$$

The positive reciprocal matrix that meets above formula is called consistent matrix. To easy define A can be accepted or not, it should test A inconsistency is very serious or not.

If A is consistent matrix, then

(1) A surely is positive reciprocal matrix.

(2)Transposed matrix A^T is consistent matrix.

(3) A matrix any two lines are in proportions, and factors are above 0, therefore $rank(A) = 1$, so is the column.

(4)In A, $\lambda_{\max} = n$, n is A matrix order number. Other features roots of A is 0.

(5) $\lambda_{\max}$ corresponding feature vector $W = (w_1, \cdots, w_n)^T$, then $a_{ij} = \frac{w_i}{w_j}, \forall i, j = 1,2,\cdots, n$, so:

$$\mathbf{A} = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \cdots & \frac{w_2}{w_n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \quad \textbf{(2)}$$

A is n order positive reciprocal matrix, when it is consistent matrix, when and only when $\lambda_{\max} = n$ as well as when A is inconsistent, it surely has $\lambda_{\max} > n$. Thereupon, use $\lambda_{\max}$ and n relationship to test whether A is consistent matrix or not.

A consistency test steps:

Calculate consistency indicator CI :

$$\mathbf{CI = \frac{\lambda_{max} - n}{n - 1}} \quad \textbf{(3)}$$

Consult corresponding average random consistency indicator RI. *Saaty* researched RI value, RI value could refer to TABLE 4.

TABLE 4 : RI value

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

RI Value is got in this way that randomly constructs 500 sample matrixes. Random select numbers from 1 to 9 as well as its reciprocals to construct positive reciprocal matrix, and determine average value of maximum feature root $\lambda'_{\max}$, and define:

$$\mathbf{RI} = \frac{\lambda'_{\max} - \mathbf{n}}{\mathbf{n-1}} \quad \textbf{(4)}$$

Solve consistency ratio CR:

$$\mathbf{CR} = \frac{\mathbf{CI}}{\mathbf{RI}} \quad \textbf{(5)}$$

When $CR < 0.10$, it is thought that A consistency is acceptable, otherwise it should make proper correction.

In the process, it also includes hierarchical total arrangement and consistency test, due to article lengths are limited, no theoretical statements here, directly apply it in the following.

CONSTRUCT OPTIMAL PSYCHOLOGICAL INFLUENTIAL SPORTS EVENTS MODEL

The purpose of establishing the model is to look for four sports events deepest influential event on university students' psychological health. So, target layer is best sports project. Considering psychological problems contain four aspects, so criterion layer contains four elements that are respectively somatization, interpersonal relationships, terror and paranoid. The model scheme layer contains swimming, running, basketball and table tennis four sports events. Hierarchical structure chart is as Figure 3.

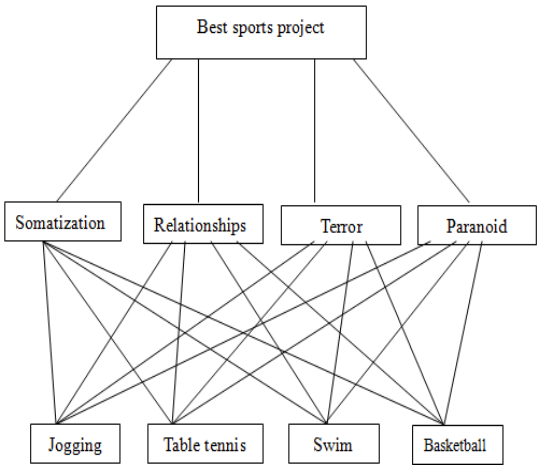

Figure 3 : Hierarchical structure of psychological problems

Judgment matrix construction

Construct judgment matrix firstly should define criterion layer four factors importance comparison. Carry out percentage processing with TABLE 2 data, it can get TABLE 5.

TABLE 5 : Factor comparison table

	Percentage (%)	Rank
Somatization	24.26%	3
Interpersonal relationships	26.29%	2
Terror	22.98%	4
Paranoid	26.47%	1

According to TABLE 5 data, we establish target layer paired comparison matrix, as TABLE 6 show.

Table 6 : Target layer paired comparison matrix

A	B_1	B_2	B_3	B_4
B_1	1	1/3	3	1/3
B_2	3	1	4	1/2
B_3	1/3	1/4	1	1/5
B_4	3	2	5	1

And then, establish criterion layer paired matrix, contents are as TABLE 7-10.

TABLE 7 : Criterion layer paired matrix one

B_1	P_1	P_2	P_3	P_4
P_1	1	1/2	1/3	1/4
P_2	2	1	1/2	1/3
P_3	3	2	1	1/2
P_4	4	3	2	1

TABLE 8 : Criterion layer paired matrix two

B_2	P_1	P_2	P_3	P_4
P_1	1	2	1/2	1/3
P_2	1/2	1	1/3	1/4
P_3	2	3	1	1/2
P_4	3	4	2	1

TABLE 9 : Criterion layer paired matrix three

B_3	P_1	P_2	P_3	P_4
P_1	1	1/3	1/2	1/5
P_2	3	1	1/3	1/2
P_3	2	3	1	1/3
P_4	5	2	3	1

TABLE 10 : Criterion layer paired matrix four

B_4	P_1	P_2	P_3	P_4
P_1	1	2	3	4
P_2	1/2	1	2	3
P_3	1/3	1/2	1	2
P_4	1/4	1/3	1/2	1

Computed result

The model involved algorithm can be implemented by *Matlab* software programming; thereupon it gets computed result as TABLE 11.

TABLE 11 : Hierarchical total arrangement

Criterion		Somatization	Interpersonal relationships	Terror	Paranoid	Total arrangement weight
Criterion layer weight		**0.1522**	**0.3132**	**0.0713**	**0.4633**	
Scheme layer single arrangement	Swimming	0.0954	0.1601	0.0863	0.4673	0.0178
	Running	0.1601	0.0954	0.1769	0.2772	0.0178
	Basketball	0.2772	0.2772	0.2612	0.1601	0.172
	Table tennis	0.4673	0.4673	0.4756	0.0954	0.0178

From TABLE 11, we can see that basketball is most beneficial to university students' psychological health.

CONCLUSION

The key step of analytic hierarchy process is to abstract practical problems into hierarchical structure with certain logic relations. To small partial practical problems, abstraction work is not easy to carry on. The drawback of analytic hierarchy process is making comparison values between two factors, once extracted value is unreasonable, judgment result will appear deviation.

The paper applies analytic hierarchy process into judging university students' psychological deepest influential sports events, takes swimming, running, basketball and table tennis as judgment objects, obtained result is the biggest influential effective sports event on university psychology is basketball, such result conforms to the article "Sports optional courses teaching to university students psychological health influences research" stated opinion "Ball type and rhythmic gymnastics type optional courses could propel to university students' psychological health development", so that proves obtained result authenticity and rationality.

REFERENCES

[1] Chen Po, Qin Zhong-Mei, Yin Ying, Xia Chong-De; Correlation Analysis of Current Situation of Regional Athletics Sports Development and Society Population Structure in China. Journal of Beijing Sport University, **30(12)**, 1610-1613 **(2007)**.

[2] Guo Hong; Summary on Chinese Sports Population Research Since 1980s. China Sport Science and Technology, **43(3)**, 36-40 **(2007)**.

[3] Li Hong, Xue Hai-hong, Feng Wu-long; Sociological Analysis of Comparison of Chinese Population with the Sports Population of Chinese. Journal of Xi'an Institute of Physical Education, **24(4)**, 5-28 **(2007)**.

[4] Li Lin, Yang Jie, Yang Tian, Xu Lie-hui; A Research on the Sustainable Development of Evaluation Index System of Regional Sports Industry. Journal of Beijing Sport University, **9**, **(2010)**.

[5] Miao Zhi-wen, Qin Chun-lin; Sociological analysis of contemporary Chinese sports population structures. Journal of Physical Education, **13(1)**, 119-121 **(2006)**.

[6] Xiao Huan-yu, Fang Li; Concept, Classification and Statistical Criteria of Sports Population. Sports Science Research, **26(1)**, 7-10 **(2005)**.

[7] Xiao Huan-yu, Weng Zhi-qiang, Chen Yu-zhong; Basic Characteristics of Social and Sports Population Structures of Contemporary China. Journal of Shanghai Physical Education Institute, **29(2)**, 10-14 **(2005)**.

[8] Xue Jin-xia, Wang Jing-tong; Analysis on Development Level of Competitive Sports of Eastern China in the "Eleventh Five-Year" Period. Bulletin of Sport Science & Technology, **19(4)**, 57-59 **(2011)**.

[9] Yan De-yi; Development of sports for all under circumstance of building well-off society. Journal of Wuhan Institute of Physical Education, **40(1)**, 15-19 **(2006)**.