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Badminton training influence factors research based on AHP analysis

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ABSTRACT

Whole journey many years training is the premise that ensures Chinese badminton competitive level keeps world advanced level for a long-term. The paper adopts analytic hierarchy process to carry out quantitative analysis of whole journey many years training's each factor, and finds out main influence factors, and make improvement accordingly. At first, by expert interview, questionnaire survey, it explores Chinese excellent badminton players whole journey many years training process phases features and whole process relative influence factors, and then combine with analytic hierarchy process, it constructs judgment matrix and utilizes Matlab program to solve, finally according to program solution result, it analyzes relative influence factors and makes suggestions, with an aim to improve badminton training level.

KEYWORDS

Analytic hierarchy process;
Matlab;
Training level;
Judgment matrix;
Badminton.

INTRODUCTION

For badminton, an excellent athlete cultivation normally needs dozens years or even twenty years, due to training time is too long, it will suffer all kinds of factors influences in training process. To ensure many years training can achieve ideal effects that is to cultivate high level badminton player, it requires to make overall coherent planning for the whole training process so that improve training efficiency.

For badminton training, lots of predecessors have made researches. Just by these predecessors' constant efforts, it makes Chinese badminton always in world advanced level. From which, Zhou Zhi-Hui (2012) researched on current badminton circle five top talents' technical and tactics features, and got the conclusion: with badminton development, hitting drop point has already changed from traditional four points control to net control to restrict opponent attack, and created opportunity to let its own party attack, attack routes and drop point were flexible and changeable. And made suggestions: When served and received, strengthen hitting route, drop point, hitting opportunity changes, strengthen control and counter control abilities training, tried to restrict opponent attack in multiple rackets, and positively created opportunity to attack. Focus on strengthening previous 11 rackets technical and tactics training and winners training, and strengthen multiple rackets moment hitting technique stability, reduced unnecessary mistakes[1]. Li Yong-Bo (2007) made research on Chinese badminton team current status and sustainable development strategy and pointed out the new competition rule weaken Chinese badminton team traditional advantages to great extent, to maintain Chinese badminton team continuously leading role in world badminton, it should further strengthen research on new

competition system competition rules, intensified coaches job training system, and relied on quantified indicators, paid special attention to training details[2]. Feng Bo(20103)did research on world excellent badminton men's singles players scores and outcome relations, suggested to quantize forced errors and unforced errors so that could make clear each technique merits status, and further guided Chinese men's singles badminton training[3].

The paper combines with previous results, applies analytic hierarchy process, makes research on badminton whole journey years training, finds out badminton training uppermost influence factors, so that make improvement suggestions on these factors, and optimizes Chinese badminton whole journey years training mode, with an aim to make contributions to Chinese badminton development.

BADMINTON TRAINING INFLUENCE FACTORS ANALYTIC HIERARCHY PROCESS MODEL

Badminton whole journey years training process is a extremely complicated process, suffered influence factors are complex and multilevel, it has direct factors and also indirect factors, the paper finds out the main influence factors from complex influence factors, targeted improving influence factors is effective measure to improve training level. The paper combines with analytic hierarchy process(is called AHP for short) to research on badminton whole journey years training influence factors and construct judgment matrix, so that finds out its main influence factors.

AHP model construction

Chinese badminton players' whole journey years training influence factors are various, analytic hierarchy process can classify complicated each factor into correlation ordered layer, make it methodical, targeting. The detailed steps are as following

1) Construct hierarchical model

By questionnaire and expert interview, it researches Chinese badminton whole journey years training influence factors and mutual relations, it can construct each factor into several layers according to different properties, each layer affects previous layer from bottom to top. In general, it can be divided into three layers: object layer, criterion layer and project layer.

①Objective layer

Only one element in this hierarchy, it normally is intended objective o of analytic problems. Objective layer is the key to analytic hierarchy process model establishment. Therefore analytic hierarchy process surely includes objective layer, and only one element in objective layer.

②Criterion layer

Criterion layer includes all intermediate links that get involved to fulfill objective layer expected effects, it is composed of one or several layers, in general, it takes one to two layers to simplify model.

③Project layer

Factors included in project layer are optional detailed plans, detailed solution steps, measures and so on to fulfill objectives, therefore it also can be called measure layer.

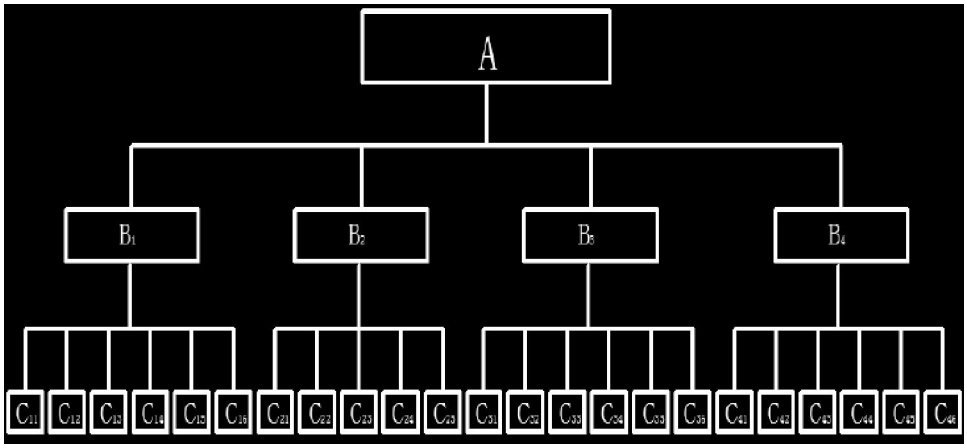

Figure 1 : Badminton training influence factors hierarchical structural chart

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When establishing hierarchical structure, number of layers is not limited that has connections with detailed problems features. To every layer each factor governing next layer factor, it has limitation and normally will not go beyond nine. That's because too many governed elements will cause following constructed judgment matrix be too complicated, reduce result accuracy. To badminton training, it can establish hierarchical structure as following Figure 1 show, relative symbols descriptions can refer to TABLE 1.

TABLE 1 : Explanation in Figure 1 symbols

A	Whole journey years training process influence factors	C_{24}	Site facility
B_1	Environment factor	C_{25}	Scientific research development
B_2	Cofactor	C_{31}	Athlete training motivation
B_3	Main factor	C_{32}	Athlete injury
B_4	Key factor	C_{33}	Athlete willpower
C_{11}	Political stability	C_{34}	Athlete family support level
C_{12}	National political stability	C_{35}	Athlete cultural quality
C_{13}	Financial investment to badminton	C_{36}	Athlete physical qualifications
C_{14}	Social support level	C_{41}	Coach training capacity
C_{15}	National emphasis	C_{42}	Coach health
C_{16}	Cultural background	C_{43}	Coach moral cultivation
C_{21}	Physical training	C_{44}	Coach cultural quality
C_{22}	Management system	C_{45}	Coach management ability
C_{23}	Rules changes	C_{46}	Coach innovation consciousness

2) Construct judgment matrix

In Figure 1, it reflects badminton players whole journey years training each factor relations, when defining these factors proportions (that is weight), these factors proportions normally are not easy to quantitatively define, and if these factors influence factors are more, when constructing judgment matrix, it tends to cause decision- makers provide mutual contradiction data due of ill-considered and out at elbows. The paper quotes Saaty proposed paired comparison method on factors to establish paired comparative construction judgment matrix. That is every time in the same layer, it takes two factors x_i and x_j, and use a_{ij} expressing x_i and x_j to factor Z influences, whole comparison result can use matrix $D=(a_{ij})_{n\times n}$ to express, call D as $Z-X$ judgment matrix. It is easy seen if x_i and x_j to Z influence ratio is a_{ij}, and then and to influence ratio is $a_{ji}=\frac{1}{a_{ij}}$.

Regarding a_{ij} value determination method, this paper quotes Saaty suggested number 1~9 and its reciprocal as scale. As following TABLE 2 show.

3) Calculate weight vector

For constructing judgment matrix, weight vector calculation method is: adopting extraction of root calculating maximum feature vector and maximum feature root. Solve the sum of A each row vector and take its average value, and then make normalization. Its formula is:

$$w_i=\frac{\left(\prod_{j=1}^{n}a_{ij}\right)^{\frac{1}{n}}}{\sum_{k=1}^{n}\left(\prod_{j=1}^{n}a_{kj}\right)^{\frac{1}{n}}}\quad i=1,2,\mathrm{L},n \qquad (1)$$

According to formula(1) and following calculation steps: Step one: A elements multiplied according to column and gets a new vector; Step two: Let each new vector every component extracts n powersÿStep three: After making normalization of all vectors that gets weight vectors. $w=(w_1,w_2,\cdots w_n)^T$ is approximate feature vector.

4) Consistency test

① Calculate consistency indicator

Test consistency, at first it needs to firstly calculate

TABLE 2 : Definition of scale

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 value of above adjacent judgment
Reciprocal	If factor i and factor j importance ratio is a_{ij}, and then factor j and factor i importance ratio is $a_{ji}=1/a_{ij}$

TABLE 3 : Average random consistency indicator RI

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

matrix maximum feature root λ_{max} :

$$\lambda_{max}=\sum_{i-1}^{n}\frac{(AW)}{nw_i}=\frac{1}{n}\sum_{i-1}^{n}\frac{\sum_{j=1}^{n}a_{ij}w_j}{w_i} \quad (2)$$

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

② Find out corresponding average consistency indicator RI . TABLE 3 provides 1~9 order positive and negative matrix average random consistency indicator.

RI value is got in this way that uses random method constructing 500 pieces of samples matrix: extract numbers from 1~9 and its reciprocal at random to construct reciprocal matrix, it solves maximum feature root average value λ'_{max}, and defines:

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

③ Calculate consistency proportion CR

n order reciprocal matrix A is consistent matrix when and only when its maximum feature root $\lambda_{max}=n$, and when reciprocal matrix A is not consistent, it surely has $\lambda_{max}>n$. A inconsistency degree will get more serious, λ_{max} corresponding standard feature vector would also cannot realistic reflect $X=\{x_1,\cdots,x_n\}$ proportion in factor z influence. Therefore, it is necessary to do consistency test at decision makers provided judgment matrix to decide whether can accept it or not.

TABLE 4: *B* layer constructed judgment matrix

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

TABLE 5 : (Environment factor) Single arrangement indicator weight calculation and test result

B_1	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	w_1	Consistency test indicator value
C_{11}	1	1/2	1/3	1/4	1/4	1/2	0.0587	$\lambda_{max}=6.096$
C_{12}	2	1	1/2	1/3	1/3	1/2	0.08709	
C_{13}	3	2	1	1/2	1/2	2	0.1693	CI $=0.019$
C_{14}	4	3	2	1	1	3	0.28758	RI $=1.24$
C_{15}	4	3	2	1	1	3	0.28758	
C_{16}	2	2	1/2	1/3	1/3	1	0.10973	CR $=0.0154$

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TABLE 6 : (Cofactor) Single arrangement indicator weight calculation and test result

B_2	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	w_2	Consistency test indicator value
C_{21}	1	2	4	4	3	0.41	$\lambda_{max} = 5.114$
C_{22}	1/2	1	3	3	2	0,255	
C_{23}	1/4	1/3	1	2	1/2	0.100	$CI = 0.029$
C_{24}	1/4	1/3	1/2	1	1/3	0.07	$RI = 1.22$
C_{25}	1/3	1/2	2	3	1	0.165	$CR = 0.026$

TABLE 7 : (Main factor) Single arrangement indicator weight calculation and test result

B_3	C_{31}	C_{32}	C_{33}	C_{34}	C_{35}	C_{36}	w_3	Consistency test indicator value
C_{31}	1	1/2	1/2	3	3	2	0.1877	λ_{max} = 6.1488
C_{32}	2	1	1	3	3	2	0.2654	
C_{33}	2	1	1	3	3	2	0.2654	CI = 0.03
C_{34}	1/3	1/3	1/3	1	2	1/2	0.0843	RI = 1.24
C_{35}	1/3	1/3	1/3	1/2	1	1/2	0.067	
C_{36}	1/2	1/2	1/2	2	2	1	0.1301	CR = 0.024

Calculate consistency proportion CR as:

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

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

MODEL SOLUTION AND RESULT ANALYSIS

According to above analytic hierarchy process principle and steps, it can construct judgment matrix as following TABLE 4 to single arrangement by combining with TABLE 2.

By Matlab programming, it can get the judgment matrix weights are respectively $B_1 = 0.07$, $B_2 = 0.1046$, $B_3 = 0.3308$, $B_4 = 0.4946$, consistency indicators values are $\lambda_{max} = 4.088$, $CI = 0.029$, $RI = 0.9$, $CR = 0.0327$, from which $CR < 0.10$ it can think that judgment matrix consistency is acceptable, therefore each weight value is scientific. According to above process, similarly it can get each factor hierarchical arrangement indicator weight calculation and test result as following TABLE 5, TABLE 6, In TABLE 5, TABLE 6, TABLE 7, TABLE 8 consistency test indicators, all CR is less than 0.1, therefore matrix consistency is acceptable, result is persuasive.

By TABLE 4 weight result, it can define coach factors weight values are highest which play key roles in the whole training, therefore coach layer is the key factor in whole journey years training. Athlete influence factor ranks the second, athlete is training main object, is whole journey years training main influence factors.

Combine with TABLE 4, TABLE 5, TABLE 6, TABLE 7, TABLE 8, it can define C layer weight, its algorithm formula is:

TABLE 8 : (Key factor) Single arrangement indicator weight calculation and test result

B_4	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{46}	w_4	Consistency test indicator value
C_{41}	1	4	2	3	2	2	0.3080	λ_{max} = 6.108
C_{42}	1/4	1	1/3	1/2	1/4	1/4	0.053	
C_{43}	1/2	3	1	2	1/2	1/2	0.137	CI = 0.0217
C_{44}	1/3	2	1/2	1	1/2	1/2	0.095	RI = 1.24
C_{45}	1/2	4	2	2	1	1	0.203	
C_{46}	1/2	4	2	2	1	1	0.203	CR = 0.017

$$w = w_{Bi} \times w_{Ciz} \quad (6)$$

Therefore, it can get whole journey years training influence factors ranking as TABLE 9 show.

According to TABLE 9, it is clear that Chinese badminton players whole journey years training influence factors are: from the perspective micro-level, coach training capacity, management capacity, innovation consciousness are the key factors. Athlete injury, willpower, and training motivation are the main factors. From the perspective of intermediate level, training system, management system, scientific research levels are the main cofactors. From the perspective of macro-level, national emphasis, economic investment, social support level is the main environment factor. In future badminton undertakings, it should put coaches' cultivation in the first place, meanwhile it can also not relax in athletes' willpower cultivation and training motivation guiding. So that improves coaches and athletes working efficiency, and propel to badminton rapid development.

TABLE 9 : Whole journey years training influence factors ranking table

Influence degree ranking	Influence factor	Influence degree ranking	Influence factor
1	Coach training capacity	11	Coach health
2	Coach management ability	12	Athlete cultural quality
2	Coach innovation consciousness	13	National emphasis
3	Athlete injury	13	Financial investment to badminton
3	Athlete willpower	14	Scientific research development
4	Coach moral cultivation	15	Social support level
5	Athlete training motivation	16	Rules changes
6	Coach cultural quality	17	Cultural background
7	Athlete physical qualifications	18	Site facility
8	Training system	19	National political stability
9	Athlete family support level	20	International political stability
10	Management system		

CONCLUSIONS

This research adopts analytic hierarchy process to make research on Chinese badminton players' whole journey years training process influence factors, and establishes analytic hierarchy process model. The model has widely application, and can promote to more sports items training; for Chinese excellent badminton players whole journey years training influence factors, it makes analysis and gets that from the perspective micro-level, coach training capacityÿmanagement capacity, innovation consciousness are the key factors. Athlete injury, willpower, and training motivation are the main factors. From the perspective of intermediate level, training system, management system, scientific research levels are the main cofactors. From the perspective of macro-level, national emphasis, economic investment, social support level is the main environment factor. According to whole journey years training process influence factors, it makes following suggestions: develop and cultivate coaches from excellent ex-service athletes, strengthen coaches' cultivation. Expand reserve forces quantity and quality, balance regional development, reduce sports injury, improve athletes' attitudes of mind, and intensify education.

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