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Bayes discriminant analysis-based juvenile volleyball athlete sports quality criterion research

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ABSTRACT

Youth volleyball plays a very important role in juvenile physical quality, healthy growth. At the present stage, China has already enlarged selection and cultivation on juvenile volleyball athletes, and got certain achievements. No doubt, juvenile volleyball athlete sports quality criterion research has become an important task of Chinese volleyball sustainable development. The paper mainly utilizes Bayes discriminant analysis method, firstly it makes a general survey of world juvenile volleyball athlete management mode, researches on its management superiorities and management philosophy, and on this basis, it horizontally researches on present stage Chinese juvenile volleyball athlete status, and puts forward existing issues. Secondly, establish Bayes discriminant analysis-based juvenile volleyball athlete sports quality criterion research model. Combine with juvenile volleyball sports quality affected speed quality, power quality, springing quality and sensitive quality such four items' first grade indicators, it defines corresponding second grade indicators that 30m standing start, medicine ball throwing, running-up reach, V moving and total performance Bayes discriminant classification function. In addition, it makes model improvement on this basis, considering events prior probabilities, it establishes improved Bayes discriminant classification function that improves discriminant accuracy so that defines juvenile volleyball sports quality discriminant criterion.

KEYWORDS

Juvenile volleyball;
Sports quality criterion;
Bayes discriminant analysis;
Model improvement.

INTRODUCTION

Volleyball was originated from America as earliest; it was up to American missionaries, churches, as well as military officers, soldiers to spread around all places in the world. Volleyball is not only a kind of sports events, but also will affect physical and mental health, is a kind of very wide leisure activities in life. Juvenile volleyball is the base of volleyball, research on its selection and cultivation criterion plays key roles in juvenile volleyball and national volleyball sustainable development. Therefore, lots of scholars have made researches on it.

Gong De-Gui and others in juvenile volleyball athlete technical level affected psychological factors research; they combined with a great deal of reference documents, and investigated on national juvenile vol-

leyball athlete cultivation organizations, used documents literature, questionnaire, data analysis method and others to make further analysis, so that they put forward juvenile volleyball athlete technical effects affected psychological factors and got corresponding solution and measures; Zhong Sheng and others in the research of juvenile volleyball reserve talents, they proposed that at present stage juvenile volleyball existed main problems, combined with juvenile volleyball current status, they analyzed different genders, different regions' juveniles volleyball athletes, so that finally provided corresponding solution and measures; Zhang Jing-Jing in juvenile volleyball athlete physical quality research, she compared foreign juvenile volleyball athlete management and training modes, and combined with Chinese juvenile volleyball cultivation status, she presented juvenile volleyball athlete physical quality affected numerous factors, and training modes to promote its sustainable development; Xu Yi-Fang in the research of juvenile volleyball reserve talents cultivation, she made investigation on Chinese high level juvenile volleyball base current, obtained first-hand investigation information, and based on this, she made further researches, so that put forward problems and corresponding solutions; Lai Zhi-Rong in juvenile volleyball reserve talents special sports research, he combined with juvenile volleyball athlete quality status, put forward existing problems, and utilized mathematical methods to make quantitative analysis so that got juvenile volleyball athlete quality affected physical factors and psychological factors that provided theoretical basis for juvenile volleyball athlete cultivation.

The paper mainly uses Bayes discriminant analysis method, based on world juvenile volleyball athlete management mode and current Chinese juvenile volleyball athlete status, it establishes Bayes discriminant analysis-based juvenile volleyball athlete sports quality criterion research model. Combine with juvenile volleyball athlete sports quality affected speed quality, power quality, springing quality, and sensitive quality four items first grade indicators, it defines corresponding second grade indicators and total performance Bayes discriminant classification function, and carries out model improvement, defines juvenile volleyball athlete sports quality discriminant criterion, as well as improves discriminant criterion accuracy.

VOLLEYBALL ATHLETE SPORTS QUALITY CRITERION MODEL ESTABLISHMENT

As a kind of sports leisure event, juvenile volleyball plays positive roles in juvenile healthy growth and makes talents reserve for national competitive volleyball sustainable development. Therefore, juvenile volleyball athlete cultivation and selection has become a priority among priorities. For juvenile physical quality testing, according to consulted lots of documents and scholars researches, finally it gets that mainly considers from speed quality, power quality, springing quality and sensitive quality such four aspects.

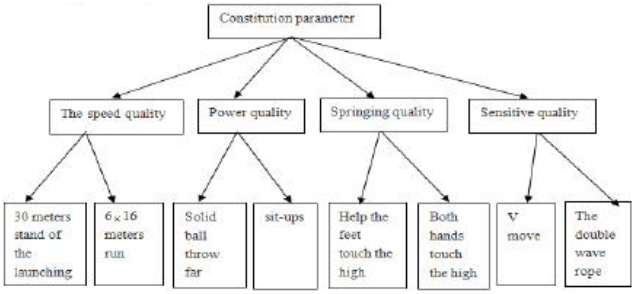

Figure 1: Movement quality evaluation index hierarchy

Above hierarchical structure Figure 1 shows: Juvenile volleyball athlete physical quality testing includes four pieces of first grade indicators and multiple second grade indicators, so as to better define juvenile volleyball athlete sports quality criterion, now it establishes mathematical model to make quantitative analysis of each indicator.

International juvenile volleyball athlete training management

Throughout world juvenile volleyball athlete development, at present most of world sports power adheres to the principle of improving juvenile volleyball athlete quality and promoting future volleyball development, it gives professional clubs' juvenile volleyball athlete cultivation aspect advantages into full play, provides most preferable training conditions and coaches sources, and sets different ages groups' juveniles reserved echelon.

For different age juveniles' volleyball athletes, it carries out special training, which provides appropriate training items and training criterions for different ages juveniles. Besides, its juvenile volleyball training mode is quite novel and unique, it adopts part-training and

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part-learning, properly extending school years' educational system, lets students do not delay their studying and relieve club burdens, so that finds more potential juvenile volleyball athlete.

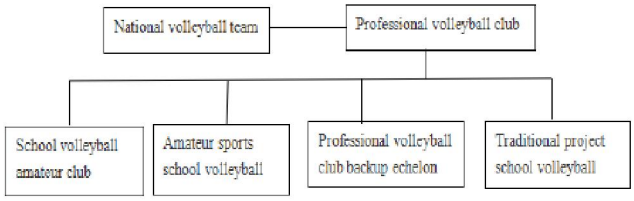

Figure 2 : International youth volleyball athletes training management mode

From above management mode Figure 2, it is clear: at present, international juvenile volleyball training management focuses on volleyball professional clubs strengths' playing, and on this basis, it establishes volleyball school amateur clubs, amateur sports school volleyball, professional volleyball club backup echelon, traditional project school volleyball and others varieties of forms, so that transports excellent juveniles volleyball athletes to national volleyball team and promotes volleyball sustainable development.

Chinese juvenile volleyball athlete present situation

Presently, number of Chinese juveniles volleyball athletes are in the rising trend, age distribution concentrates on 13~15 years old, male and female ratios are basically flat, but regional differences are relative obvious, "More in North, Less in South", is a key factor that should be taken into account when researching on juvenile volleyball athlete sports quality.

Juvenile volleyball athlete age structure

Juvenile volleyball athlete is national competitive volleyball reserve force, it the base of volleyball sustainable development and impact to world sports, and is the hope of Chinese sports. Research on juvenile volleyball athlete age structure is beneficial to design different training criterion with different age groups' juvenile physical quality so that propel to volleyball athlete more comprehensive development.

Following Figure 3 is current Chinese juvenile volleyball athletes' age structural distribution figure; data is from Chinese sports yearbook and internet data. For Figure 3 juvenile volleyball athletes' age distribution features, it makes further analysis, and provides basis for next step juvenile volleyball athletes' sports quality criterion designing.

From above area Figure 3, it can get conclusion: juvenile volleyball athlete age structure distribution is 10~12 years old, 13~15 years old, 16~19 years old. Among them, 13~15 years old athletes occupy the most part, 10~12 years old, 16~19 years old athletes occupy little proportion. In order to better promote Chinese juvenile volleyball athletes' development, it should further improve volleyball impact among 10~12 years old juveniles, start from the foundation, cultivate and transport more juvenile volleyball athletes for national volleyball and promote volleyball sustainable development.

Juvenile volleyball athlete regional and gender comparison

Affected by region, culture and gender, juvenile volleyball athlete development also presents different features. Therefore, when considers juvenile volleyball athletes' cultivation and selection, it should make different sports quality criterions, according to different regions, different genders' sports quality criterions, it goes ahead with selection and cultivation training so that can 'suit the remedy to the case' and transport excellent juvenile volleyball athletes to national volleyball.

Below are by far, different regions, different genders' juvenile volleyball athletes' percentage that occupies juvenile volleyball athletes total amount, data comes

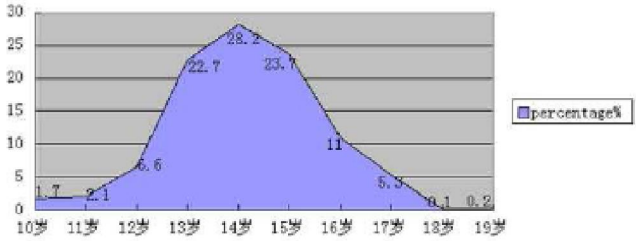

Figure 3 : Juvenile volleyball athletes age structure distribution

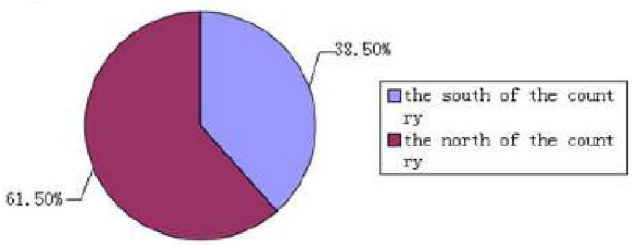

Figure 4 : South and north area percentage juvenile volleyball athletes

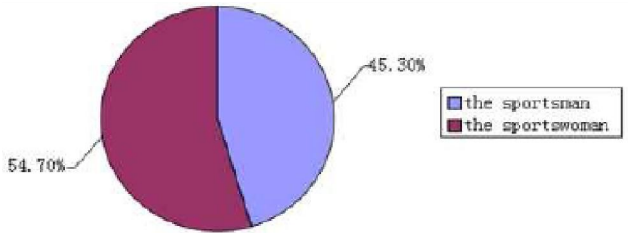

Figure 5: Juvenile volleyball athlete's ratio

from general administration of sport of China volleyball management center, according to data, it draws out pie figure, and makes further analysis.

From above pie Figure 4 and Figure 5 analysis, it is clear: in view of region, Chinese juvenile volleyball athletes basically concentrated on north, data accounts for 61.5%, south is less, on a whole, it presents the trend of ' More in north, less in south and lack in medium' that has distinct regional features; in view of genders, men and women volleyball athletes are basically flat, but relatively, women volleyball athletes are more, thinking of men volleyball and women volleyball Olympic Games performances, it should strengthen cultivate juvenile men volleyball athletes in future development, improve techniques, perfect and reform management system and constantly improve Chinese juvenile volleyball athletes' levels.

Number of juvenile volleyball athletes changes

Juvenile volleyball athletes are the mainstay of national competitive volleyball sustainable development, and the impetus to promote its development. Cultivate juvenile volleyball athletes not only conform to Chinese "Juvenile volleyball syllabus" requirements, but also have certain effects on juvenile physical and psychological health development. In recent years, China has already increased juvenile volleyball athletes' training, the number of juvenile volleyball athletes are constantly increasing.

Below is year 2008~2012 number of juvenile volleyball athletes broken line Figure 6, data is from general administration of sport of China volleyball management center, and on the basis of Figure 6, it further

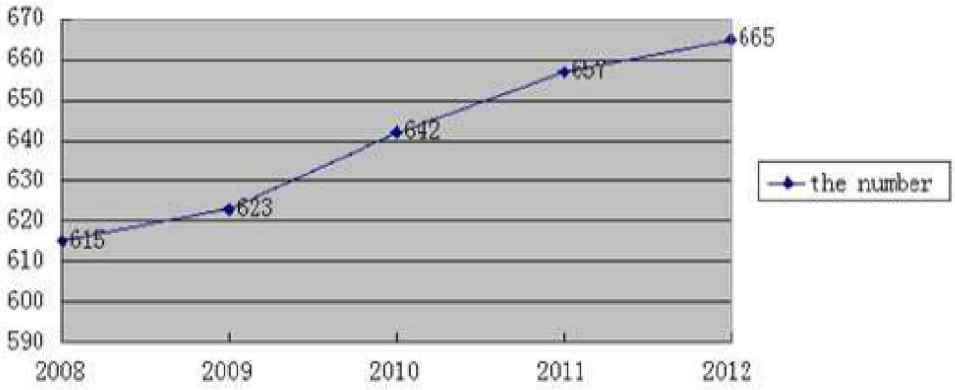

Figure 6 : The number of juvenile volleyball athletes

makes analysis, and gets conclusion.

From above broken line Figure 6, it is clear: Number of Chinese juvenile volleyball athletes is in rising trend, number of people and scale are constantly increasing, it shows that juvenile volleyball athletes' cultivation has already attracted relative sections' attentions; volleyball promotion in the range of juvenile has also been further improved.

BAYES DISCRIMINANT ANALYSIS-BASED JUVENILE VOLLEYBALL ATHLETE SPORTS QUALITY CRITERION RESEARCH

For juvenile physical quality testing, according to consulted lots of documents information and scholars researches, finally it gets that mainly considers from speed quality, power quality, springing quality and sensitive quality such four aspects, and defines corresponding second grade indicators: 30m standing start, medicine ball throwing, running-up reach, and V moving four items.

Model preparations

Discriminant analysis is a kind of multiple statistical analysis method; it refers to observe on known evaluation indicators and according to observed data to make classification on evaluation objects. Discriminant analysis general steps are as following Figure 7:

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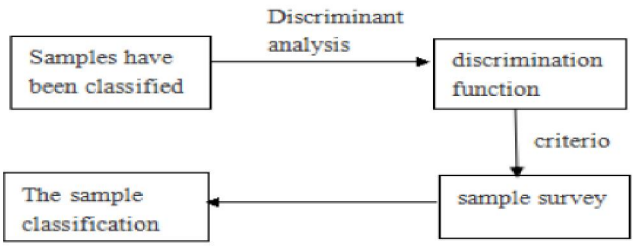

Figure 7: Discriminant analysis step

Discriminant analysis firstly should establish discrimination function, and then according to discrimination function, it makes classification on observed data. Common used discriminant methods are Bayes discriminant analysis (Fisher discriminant analysis) logistic discriminant stepwise discriminant analysis0 maximum likelihood method and so on. It introduces Bayes discriminant analysis here.

Establish Bayes discriminant analysis model

Bayes discriminant analysis is a kind of method that analyzes two classes or multiple classes data, here juvenile volleyball athlete sports quality criterion should make analysis according to his age structure and gender, so use Bayes discriminant analysis is most suitable.

Under Bayes discriminant analysis discrimination criterion, established classification function form is:

$$\begin{cases} y_1 = c_{01} + c_{11}x_1 + c_{21}x_2 + c_{31}x_3 + \cdots + c_{p1}x_p \\ y_2 = c_{02} + c_{12}x_1 + c_{22}x_2 + c_{32}x_3 + \cdots + c_{p2}x_p \\ y_3 = c_{03} + c_{13}x_1 + c_{23}x_2 + c_{33}x_3 + \cdots + c_{p3}x_p \\ \cdots \\ y_n = c_{0n} + c_{1n}x_1 + c_{2n}x_2 + c_{3n}x_3 + \cdots + c_{pn}x_p \end{cases}$$

That is to establish regarding observed indicators and observed objects linear function equations, every equation corresponds to a class discriminant criterion, from which $c_{0j}, c_{1j}, \cdots, c_{pj}, j = 1,2,\cdots,n$ is estimated parameter. After establishing discriminant functions, input one discriminant corresponding each parameter value into above discriminant parameter, then it can know which class the object belongs to.

In the paper, divide juvenile volleyball athletes according to gender and age structure into following six classes, and according to general administration of sport of China volleyball management center investigation data, it voluntarily draws following data TABLE 1:

According to above TABLE 1 data, it carries out processing, and establishes Bayes discriminant analysis classification function equations, so that defines juvenile volleyball athlete sports quality criterion.

Establish Bayes discriminant analysis classification function

(1)Processing data

Utilize SPSS software to analyze above data, and then it can get following different genders' juvenile athletes' classification functions:

According to above coefficients TABLE 2 and TABLE 3, it can respectively get classification functions about juvenile men and women athletes:

$$y_1 = 1.730x_1 + 7.021x_2 - 1.83x_3 + 2.689x_4 - 2.694 \quad (1)$$

TABLE 1 : Juvenile men, women athletes' each performance table

	Age structure	Total performance	30m standing Start (s)	Medicine ball Throwing (m)	Running-up Reach (m)	V moving
Men	10~12	46.27	4.67	9.57	3.12	24.55
		38.75	4.48	7.01	2.89	23.17
	13~15	48.36	4.60	11.61	3.17	24.19
		39.31	4.31	9.45	3.03	22.52
	16~19	48.12	4.41	13.10	3.25	23.65
		40.07	4.17	10.88	3.13	22.52
Women	10~12	45.57	5.09	6.61	2.78	27.32
		38.03	4.77	5.22	2.68	25.36
	13~15	49.07	4.97	7.60	2.82	26.45
		34.61	4.71	2.51	2.7	24.69
	16~19	46.22	5.01	7.92	2.82	27.08
		39.44	4.62	6.78	2.74	25.3

TABLE 2 : Juvenile men athletes' evaluation indicators coefficients table

Model		Non-standardized coefficients		Standardized coefficients		
		B	Standard error	Trial version	t	Sig.
1	(Constant)	-32.482	12.056		-2.694	.226
	30m running (s)	6.728	3.889	.272	1.730	.334
	Medicine ball throwing (m)	2.104	.300	.964	7.021	.090
	Running-up reach (m)	-12.070	6.597	-.329	-1.830	.318
	V moving	2.641	.982	.490	2.689	.227

a. Dependent variable: total performance

TABLE 3 : Juvenile women athletes' evaluation indicators coefficients table

Model		Non-standardized coefficients		Standardized coefficients		
		B	Standard error	Trial version		B
1	(Constant)	-81.625	59.045		-1.382	.399
	30m running (s)	30.838	16.710	1.031	1.845	.316
	Medicine ball throwing (m)	2.048	.971	.729	2.108	.282
	Running-up reach (m)	30.783	25.490	.329	1.208	.440
	V moving	-4.744	3.596	-.905	-1.319	.413

a. Dependent variable: total performance

$$y_2 = 1.845x_1 + 2.108x_2 + 1.208x_3 - 1.319x_4 - 1.382 \quad (2)$$

Among them, y is the volleyball athlete total performance, x_1 is 30m standing start, x_2 is medicine ball throwing, x_3 is running-up reach, x_4 is V moving.

Improved Bayes discriminant analysis classification function

In order to improve discrimination accuracy, firstly add one item as prior probability; it makes improvements on above Bayes discriminant analysis classification function equations. Prior probability can properly improve discrimination accuracy, its defined criterion is according to lots of documents reports or previous a great deal of samples researches. Prior probability also calls Bayes prior, it refers to extract a sample in researched totality, the sample belongs to the m class probability as $q(y_m)$, and then call it as class m prior probability.

On the basis of prior probability, Bayes discriminant analysis classification function is converted into following form:

$$\begin{cases} y_1 = c_{01} + c_{11}x_1 + c_{21}x_2 + c_{31}x_3 + \cdots + c_{p1}x_p + \ln(q(y_1)) \\ y_2 = c_{02} + c_{12}x_1 + c_{22}x_2 + c_{32}x_3 + \cdots + c_{p2}x_p + \ln(q(y_2)) \\ y_3 = c_{03} + c_{13}x_1 + c_{23}x_2 + c_{33}x_3 + \cdots + c_{p3}x_p + \ln(q(y_3)) \\ \cdots \\ y_n = c_{0n} + c_{1n}x_1 + c_{2n}x_2 + c_{3n}x_3 + \cdots + c_{pn}x_p + \ln(q(y_n)) \end{cases}$$

According to above juvenile volleyball athlete current situations, it includes juvenile volleyball athlete age structural distribution, different regions, different genders, number of juvenile volleyball athletes changes, it can define juvenile men and women volleyball athletes' prior probabilities are respectively $q(y_1) = 0.45$, $q(y_2) = 0.55$.

On the basis of considering prior probabilities, it can further respectively get about juvenile men and women athletes' Bayes classification functions as following:

$$y_1 = 1.730x_1 + 7.021x_2 - 1.83x_3 + 2.689x_4 - 2.694 + \ln(0.45) \quad (3)$$

$$y_2 = 1.845x_1 + 2.108x_2 + 1.208x_3 - 1.319x_4 - 1.382 + \ln(0.55) \quad (4)$$

That:

$$y_1 = 1.730x_1 + 7.021x_2 - 1.83x_3 + 2.689x_4 - 3.492 \quad (5)$$

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$$y_2 = 1.845x_1 + 2.108x_2 + 1.208x_3 - 1.319x_4 - 7.360 \quad (6)$$

Above is juvenile men and women volleyball athletes' sports quality discrimination function.

Define classification criterion

According to juvenile volleyball athlete age structure distribution, it divides his sports quality criterion into three classes that are successively 10~12 years old, 13~15 years old, 16~19 years old. And different genders juvenile volleyball athletes, their classification functions are different, now it can get as following evaluation criterion:

Juvenile men volleyball athletes:

10~12 years old: $38.75 \le y_1 \le 46.27$

13~15 years old: $39.31 \le y_1 \le 48.36$

16~19 years old: $40.07 \le y_1 \le 48.12$

Juvenile women volleyball athletes:

10~12 years old: $38.03 \le y_2 \le 45.57$

13~15 years old: $34.61 \le y_2 \le 49.07$

16~19 years old: $39.44 \le y_2 \le 46.22$

According to above criterion, respectively input one juvenile volleyball athlete's 30m standing start, medicine ball throwing, running-up reach, V moving four items performances into formula(5), (6), it gets corresponding y value, and compares it with above juvenile volleyball athlete sports quality criterion that belongs to above range, so it proves the athlete conforms to a juvenile volleyball athlete criterion, otherwise, he doesn't conform to it.

Judge a volleyball athlete first grade indicator that includes speed quality, power quality, springing quality and sensitive quality such four aspects, and corresponding second grade indicators:30m standing start, medicine ball throwing, running-up reach, V moving respectively represent quantitative analysis four items first grade indicators, their every item performance high-low represents corresponding quality's levels high-low. Therefore, the discriminant criterion can be used as juvenile volleyball athlete sports quality criterion.

CONCLUSIONS

(1) The paper on the basis of researching world juvenile volleyball athlete management mode, it analyzes world sports power management philosophy, and further researches on current Chinese juvenile volleyball sports status. By quantitative analyzing its age structure, different regions, different genders juvenile volleyball athletes' proportions and recent years' number of people changes, it put forward that cultivate and select excellent juvenile volleyball athletes are an important task of current volleyball development.

(2) Utilize Bayes discriminant analysis method, by analyzing speed quality, power quality, springing quality and sensitive quality four items first grade evaluation indicators, to different genders, different age groups' juvenile 30m standing start, medicine ball throwing, running-up reach, V moving performances and total performance, it establishes Bayes discriminant analysis classification function.

(3) On the basis of Bayes discriminant analysis, it further makes improvements, takes prior probability into model account, so that improves discriminant criterion accuracy, and further gets discriminant criterion that juvenile volleyball athlete sports quality discrimination criterion.

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