Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(3):285-291

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

She minority teenagers physique and health level status and strategy research based on AHP

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ABSTRACT

Presently, worldwide human race health level is trending downward, especially for teenagers physical health status that even not optimistic. Research on how to improve teenagers' physique and health level as well as how to achieve best movement effects in shortest time have become hot spots. This research applies investigation method, document and literature method and data statistical analysis as well as other methods, collect Chinese teenagers' physique and health aspects relative data, and carry out quantitative and qualitative analysis of such data. Research shows that city and rural students height, weight and other growth and development levels have showed growth trend, but university students' physical quality is continue to slow down that reflects on explosive force, strength, endurance and other physical qualities. For sport events, apply analytic hierarchy process into researching on movement effects that bring into, it gets that teenagers go in for bicycle as well as athletic sport events training effects are the best.

Key words: Quantitative Analysis, Mathematical Analysis, Analytic Hierarchy Process (AHP), Teenagers' Physique

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INTRODUCTION

Now, Chinese teenagers physique has become worse and worse ; teenagers development is related to national progress, country's future; teenagers physique health status directly affects a country competitiveness as well as social development, teenagers sports exercise is the important linkage for improving their physiques, is base of national sports .

With regard to the actual, Wang Geng-Yong, Liu Ze-Lin [1] tease out our country's sports policies, objective systematically analyze and evaluate their implementation effects, and targeted put forward corresponding solution counter measurements on current existing problems, but their counter measurements are difficult to implement, and it cannot directly improve teenagers' physiques; Dong Xiong[2] make investigation on Taiyuan city, middle school stage students, and make suggestions for school's sports courses, but his investigated age phase is too narrow and not comprehensive, only guarantee sports course improvement not let individual physical quality get improvement; Tian Tong [3] only make investigation and research on university students, and make suggestions on their training.

Research targeted carries out investigation on teenagers' physiques and health, analyze their physical shortcomings, and implement analysis research on their daily sports exercise status, put forward suggestions of better training effects sport events, in the hope of propelling to teenagers physical quality levels improvement.

EXPERIMENTAL SECTION

MODEL ESTABLISHMENT

For teenager physique and health research, this paper combines with national teenagers' height, lung capacity, weight, standing long jump, grip and other survey results in 2010 to carry out mathematical analysis. National

teenagers' physique survey results in 2010 are as following Table 1.

Table 1: Urban and Rural students' height, weight and other indicators in 2010 compare with that in 2005

Classification	Age group (add average value) from 7 to 18					Age group (add average value) from 19 to 22				
	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5
Urban boys students	1.01	89	1.35	1.12	0.43	0.84	137	1.52	-1.29	-0.18
Urban girl students	0.79	84	0.8	1.03	0.42	0.55	102	0.27	-2.72	-0.35
Rural boy students	1.55	94	2.02	0.76	0.36	1.34	185	2.07	-0.23	-0.15
Rural girl students	1.12	81	1.15	0	0.16	0.64	123	0.34	-0.92	-0.3

Note:
M1: height (cm)
M2: lung capacity (ml)
M3: weight (kg)
M4: explosive force (standing long jump /cm)
M5: strength quality (grip/kg)

Investigation result indicates, urban and rural students as height, weight, their growth and development are continue to rise; human body physiological function reflection-lung level important indicator, under the situation that continuously reduce for years, it has an upward inflection point; Compared with year 2005, 7 to 18 age group standing long jump performance that reflects lower limbs explosive force has some improvement, while 19 to 22 age group standing long jump performance has some reductions; Compared with year 2005, 7 to 18 age group reflecting strength quality grip performance has some improvements; while 19 to 22 age group performance has some reductions but not remarkable. According to above data, it can draw following bar figures Figure 1, Figure 2 and Figure 3 with excel.

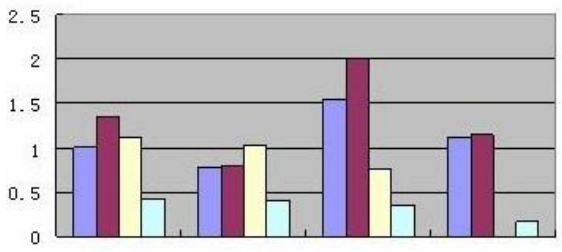

Figure 1: 7-18 years old age group body each item average added value

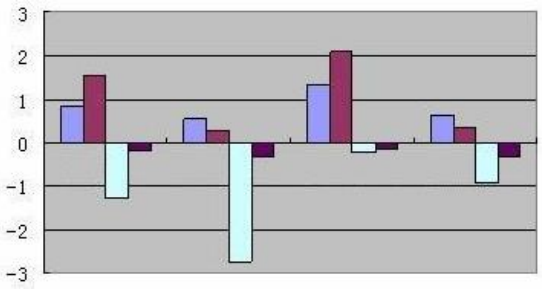

Figure 2: 9-22 years old age group body each item average added value

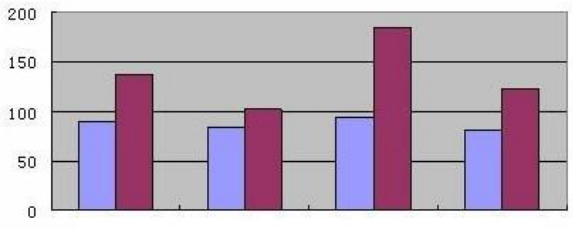

Figure 3: Lung capacity average added value

Combine with above table, it can be concluded that university students physical quality continuously is trending downward which reflects on explosive force, strength, endurance and other physical qualities. It required school or individual plan and implement some sports to improve their own physical quality.

Based on above investigation result, as well as further investigation on university students' weights, according to BMI value, make classification handling with university students' BMI value, and results as following Table 2:

Table 2:19-22 year's old age group weight investigation table

Gender	N	Lighter weight(people)	Healthy weight(people))	Overweight(people))	Obesity(people))
Urban boy students	400	12	288	55	45
Urban girl students	400	18	298	44	40
Rural boy students	400	17	305	45	33
Rural girl students	400	25	315	35	25

Results indicate that university students' obesity and overweight rate is constant increasing. Urban boy students, urban girl students, rural boy students, rural girl students' obesity rate are respectively $14.34\%,4.89\%,7.45\%,4.02\%$, by comparing with 2005, they are respectively increasing $1.87,0.67,2.45,2.52$ percentage. Overweight rates are respectively $15.55\%,8.98\%,10.8\%,7.55\%$, by comparing with 2005, they are respectively increasing $1.25,1.35,2.43,3.02$ percentage. It needs school or individual plan and implements some sports to improve their physical quality.

From which BMI is abbreviation of $Body\ Mass\ Index$, BMI in Chinese means "constitutional coefficient", is calculated with your height and weight. BMI is world recognized one kind of evaluating obesity extent grading method, world health organization (WHO) also uses BMI to define obesity or overweight.

BMI Definition formula: Body mass index (BMI) =weight (kg) ÷height^2(m)

BMI Classification is as following Table 3:

Table 3: Body mass index (BMI)

Classification	WHO standard	Asian standard	China referenced standard	Risk of relative diseases
Thinner	<18.5	<18.5	<18.5	Low(increase other diseases risks)
Normal	18.5～24.9	18.5～22.9	18.5～23.9	average level
Overweight	≥25	≥23	≥24	—
A little fat	25.0～29.9	23～24.9	24～27.9	increase
Obesity	30.0～34.9	25～29.9	≥28	moderate increase
Severe obesity	35.0～39.9	≥30	—	seriously increase
Very severely obesity	≥40.0	—	—	very seriously increase

Note: The most ideal body mass index is 22.

Chinese People's Political Consultative Committee, Committee of Education Science Culture Health and Sports implemented many times researches as well as their results indicate that some important indicators of our country teenagers physical quality are slowly reducing, we should timely make counter measurements. Obesity, heart and lung function reduce, reduced sports ability, weak-eyed detection rate improvement and others growth rate. It is consistent with our achieved result, indicates our investigation has certain reliability.

To sum up, urban and rural students have achieved different progress in body function, quality development aspects, after 2010 students' lung capacity levels improvement timely restrains before 2005 lung capacity level continuously 20 years reduction tendency, students are growing with constant stable state in speed, strength, endurance and other physical qualities, " Sports sunshine", "exercise one hour per day" and other relative policies guarantee that students have enough time to spend on sports activities. But it cannot ignore that urban students' development level are uneven, rural students body shape, strength and endurance quality aspects all fall behind urban students' development.

Human physique is double affected by inheritance and environment. Physical ability and health are mainly up to living environment, living styles, nutrition natural conditions' genetic structure development changes, health and sports training are acquired disposition. Nutrition, health is mainly through material living conditions effects on body, human health, development constraints weaker social economic levels. While positive participate in sports training can more strengthen people's physical quality, and such way less constrained by social economic development level, it easier to organize and last. Therefore, it also makes following researches on sports activities, let students carry out most effective training in minimum training time so that improve their physical quality.

Therefore, select following some sports events to calculate and make comparison, as Table 4.

Table 4: Eight sports events calories consumption as well as their influences on physical quality

No.	Sport events	Calories consumption(cal./ every half an hour)	Influences
1	Athletics	450	It can exercise whole human body.
2	Basketball	250	It can increase flexibility, strengthen heart and lung capacity
3	Bicycle	330	It is very helpful for heart and lung, legs
4	Jog	300	It is helpful for heart and lung as well as blood circulation. The longer distance runs, the larger calories would consume.
5	Walk	75	It is helpful for heart and lung function, and can improve blood circulation, move joints and helpful for losing weight.
6	Rope skipping	400	It is a beauty building movements; it has relative great effects on heart and lung system as well as other organs, coordination, posture and loses weight.
7	Volleyball	175	Mainly strengthen flexibility, jump ability and physical force, it is helpful for heart and lung
8	Table tennis	180	Belongs to whole body movements, it is helpful for heart and lung, it can exercise gravity center shifting and coordination

(Note: Above calories'cal, all refers to kilocalorie (large calorie))

It can assume:

Formula 1: exercise workout $w_{in} = a_i x_1 + b_i x_2 + c_i x_3 + d_i x_4$

From which, x_1 is sport event consumed calories, x_2 is sport court, x_3 is sport equipment, x_4 is sport event influence on physical quality, $i = 1,2,3,4,5,6,7,8$, a_{ij}, b_{ij}, c_{ij}, d_{ij} is each item influence factor. $n = 1,2$, from which 1 represents city, 2 represents village.

In the following use analytic hierarchy analysis to solve each item weight:

(1) Establish hierarchical structure:

By analysis, it can get that sports events influence on sports effect reflect in sports consumption calories, sports court, sports equipment expense, sports event effects on body and so on these 4 aspects. Establish them and sports effects' hierarchical structure between as following Figure 4 shows:

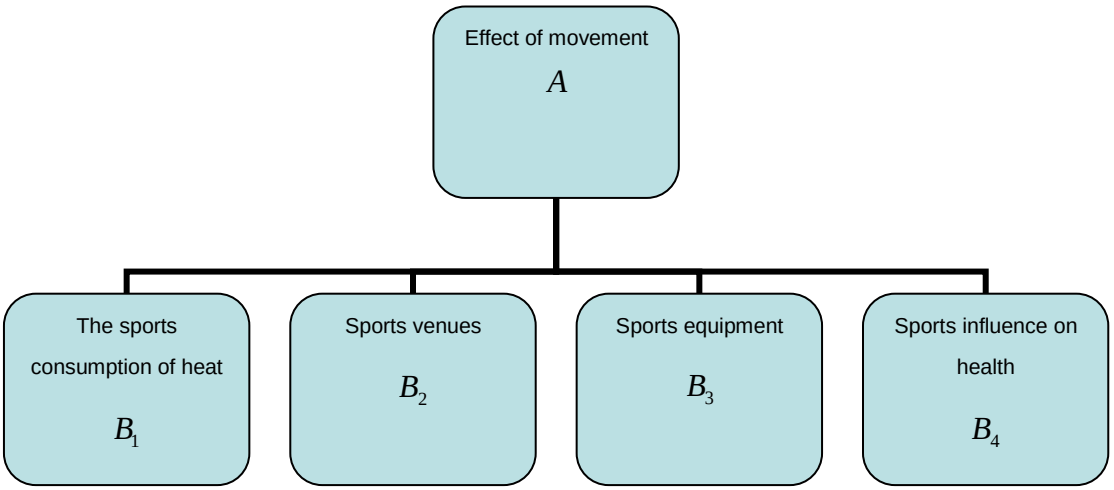

Figure 4: Sports effects' hierarchical structure

(2) Construct judgment matrix:

Hierarchical structure can clearly reflect relations among each element, but criterion layer's each criterion weight covers the targets measurement is not always the same. This paper adopts establishing paired comparison matrix method on factor B to carry out paired comparison. Which is taking two factors B_i and B_j every time，with m_{ij} representing B_i and B_j affect A ratios, whole comparison result use matrix $C = (m_{ij})_{n \times n}$ to express，it called C as $A-B$ paired comparison judgment matrix, it is called judgment matrix for short. According to experts' paired score comparison among B_1, B_2, B_3, B_4, it can get judgment matrix C formula(1):

$$C=\begin{bmatrix} 1 & 7 & \frac{7}{2} & \frac{7}{3} \\ \frac{1}{7} & 1 & \frac{1}{2} & \frac{1}{3} \\ \frac{2}{7} & 2 & 1 & \frac{2}{3} \\ \frac{3}{7} & 3 & \frac{3}{2} & 1 \end{bmatrix} \tag{1}$$

With the help of *Matlab* calculation, it can get formula (2):

$$v=\begin{pmatrix} 0.54 \\ 0.08 \\ 0.15 \\ 0.23 \end{pmatrix} \tag{2}$$

(3) Hierarchical single arrangement and consistency test:

Judgment matrix C corresponds to maximum feature value $\lambda_{\max}$ feature vector v, it is the priority weight of same hierarchy corresponding elements that is relative important to last hierarchy some element after normalization, the process is called hierarchical single arrangement.

Consistency indicator:

$$CI=\frac{\lambda-n}{n-1} \tag{3}$$

When $CI=0$, C is consistency matrix, the larger CI is, the more seriously inconsistency extent C would be. Random consistency indicator RI values as Table 5 shows:

Table 5: Random consistency indicator RI

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

For $n\geq 3$ paired comparison matrix C, it is called its consistency indicator and same order (refers to n is the same) random consistency indicator RI ratio as consistency ratio CR, when formula (4) is true, it is thought that C inconsistency extent is within permissible range, it can use its feature vector as weight vector.

$$CR=\frac{CI}{RI}<0.1 \tag{4}$$

Use Matlab calculating each matrix maximum feature value as $\lambda_{\max}=4=n$, therefore CR is surely less than 0.1, therefore comparison matrix C meet consistency test. So v can be taken as weight vector, that is $a_i=0.54$, $b_i=0.08$, $c_i=0.15$, $d_i=0.23$.

Among them: Each sports item consumed calories x_1 respectively takes values in Table 5.

Each sport court x_2 by experts scoring, respectively value:6, 10, 2, 2, 2, 1, 7, 7。

Each sports equipment x_3 values according to consulting expense。

Each sports influence x_4 according to above Table 5 can respectively take :9, 5, 7, 5, 7, 8, 8, 7。

Each sports equipment expense as following Table 6:

Table 6: Each sports equipment average expense per capita (unit: Yuan)

Equipment	Village	City
Basketball	50	100
Bicycle	300	800
Rope skipping	10	100
Volleyball	20	100
Table tennis racket	20	250

Input these parameters and influence factors into formula $w_{in} = a_i x_1 + b_i x_2 + c_i x_3 + d_i x_4$ it can get formula (5):

$$w_{in} = \begin{bmatrix} 245.55 & 245.55 \\ 151.95 & 144.45 \\ 299.97 & 224.97 \\ 163.31 & 163.31 \\ 42.27 & 42.27 \\ 232.92 & 219.42 \\ 111.9 & 99.9 \\ 136.87 & 102.37 \end{bmatrix} \tag{5}$$

From the result, it can get following conclusions: For urban students, bicycle exercise effect is the best; walk exercise effect is the worst; while for rural students, athletics exercise effect is the best, and walk exercise effect is the worst. Other sports events' exercise effect ranks as following Table 7:

Table 7: Each sport event exercise effect ranking

Sport event	Village	Urban
Athletics	1	2
Basketball	5	5
Bicycle	2	1
Jog	4	4
Walk	8	8
Rope skipping	3	3
Volleyball	7	7
Table tennis	6	6

Therefore, it suggests that urban students go to school and go home by riding a bike, so that achieve exercise effects on the condition of insufficient time to improve their physical quality. For rural students, it suggests that they run to school and home so as to achieve exercise effects, improve their physical quality. Boy students and girl students can take their own choice on sports events according to their interests.

Fore exercisers, it is necessary to guarantee a certain heart rate, if define maximum heart rate according to ages, normal heart rate increases with ages. Computational formula is like this: men maximum heart rate=205-ages. Women maximum heart rate=220-ages. International normal use 220 -ages=maximum heart rate; Effective heart rate range when taking exercises: normal exercise maximum heart rate is proper and effective sports heart rate range.

No matter aerobics or non-aerobics, only proper heart rate can achieve optimal exercise effects. Common formula is: (Maximum heart rate- before exercising heart rate)/2+ before exercising heart rate. The formula can reflect different genders, ages' heart rate. The formula is adapted to aerobics and non-aerobics, though sports forms are different in aerobics and non-aerobics, all can improve its own heart rate when taking exercise. For example, in interval training involved in exercise, as swimming in normal status, control heart speed ratio in the best range of 120-150 /min. Generally, students' heart rate is controlled in 130-150 time/min during running. Therefore, no matter you are taking aerobics or non-aerobics, you can use above formula, work out its best heart speed ratio when taking exercises, so that control their heart speed ratios, let exercise effects be the best.

CONCLUSION

Through above research, it is clear that teenagers physical quality has improvements and also reductions with economic rapidly development, social fast leaping. It make hierarchical analysis of how teenagers improve their physical qualities so as to achieve best exercise effects, make its research more systematically, and concise practical, with less quantization data requirement; but due to time limits, we only consider 8 kinds of sports events, in future it can add more sports events, add more influence factors, let research considerations more comprehensive.

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