Research on Monitoring System of Students' Physical Health Condition in Colleges and Universities of China—Take College Students of Shanxi Province as Study Case

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Abstract

This article adopts the document literature, the interview investigation, the mathematical statistics, the experimental trial and so on many kinds of methods, takes health monitoring of college students' physical fitness of Shaanxi Province as study case, demonstrates and describes the structural elements, system connotation and organizational level of the monitoring system of college students' physical health status, constructs health monitoring model of college students' physical fitness. It mainly includes the body shape system, the body function system, the movement quality system and the medical examination index system. This paper aims to provide reference for sports management in Colleges and universities, so that sports management is more directional.

Keyword: Physical health status; college students in ordinary university; monitoring system

1. INTRODUCTION

The basic purpose of college physical education is to improve the health level of college students, and to monitor the health status of college students effectively. Scientific monitoring of College Students' physical health is a powerful guarantee for the scientific management of physical education in Colleges and universities, and also is the premise of improving the overall level of Chinese youth physical fitness and the overall quality of the national. According to the problems of students' physical health monitoring, many scholars have studied from different angles and levels. So far the research on the health monitoring of students' physical fitness is divided into three aspects. First, evaluative research on the data of students' physical fitness test results. Second, take the National Physical Determination Standards as an evaluation tool, demonstrative research is taken on its effectiveness. Third, research on the evaluation of influence factors of physical fitness monitoring. The research is based on the related theories of evaluation of physical health effects, combined with the characteristics of College Students' physical health monitoring, using document literature, expert interviews, questionnaire survey, Analytic Hierarchy Process (AHP) and other research methods, constructs health monitoring system of College Students' physique, discusses and analyzes its index connotation and monitoring characteristics. The purpose of this study is to enrich the theoretical content of the research on the monitoring of physical health effects, and to provide effective tools for the health monitoring of College Students' physical fitness.

2. Research Objects and Methods

2.1 Research Objects

According to the aim and task, this research selects students of seven colleges as test object, such as Xi'an Technological University, Xi'an University of Architecture and Technology, Xi'an

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University of Posts and Telecommunications, Northwest A&F University, Chang’an University, Yulin University, Yan’an University. The total number of subjects is 4088, in which, there are 2344 boys and 1744 girls. All the data in this paper are randomly selected.

2.2 Research Methods

2.2.1 Literature Data Method

2.2.2 Expert Interview Method

In order to screen and determine the health monitoring indexes of College Students' physical fitness more accurately, in this study, a total of two categories of 34 experts are interviewed. First, experts are engaged in the research of school physical education and students' physical health in the government's scientific research department; Second, Professors and scholars who are engaged in the study of physical health education in Colleges and universities. Issued 67 questionnaires, recover 64 copies, the recovery rate is 95.5%, the effective questionnaires are 64 copies, the effective rate is 95.5%.

2.2.3 Questionnaire Survey Method

In order to ensure the monitoring index of screening and establishment more accurate and reasonable, the establishment of College Students' physical health monitoring system more scientific and systematic, three rounds of selection of monitoring indicators are carried out in this study. The basic steps of index construction: (1) Selection of Indicators: Through reading a lot of document literature, select all aspects of the test indicators comprehensively, then sum up and classify the index, complete index selection; (2) Selection of Experts: After consulting and investigating with relevant experts, professors and scholars many rounds, build a complete index system initially; (3) the Test: Test the index system which constructed initially, then adjust it according to the feedback, make it perfectly.

This research mainly designs "Research on The Construction of Monitoring Index System of College Students' Physical Health Status" Physical Health Expert Questionnaires and four expert questionnaires of two level index monitoring system, a total of 5 copies, the content of the questionnaire is recognized by the majority of experts and professors, as shown in Table 1.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Fully Recognize N</th>
<th>More Recognize N</th>
<th>General Recognize N</th>
<th>A Little Recognize N</th>
<th>Not Recognize N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert Questionnaire of College Students' Physical Health Monitoring N=15</td>
<td>3 20</td>
<td>6 40</td>
<td>5 33.3</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>Expert Questionnaire of College Students' Body Shape Monitoring N=12</td>
<td>2 16.7</td>
<td>4 33.3</td>
<td>6 50</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>Expert Questionnaire of College Students' Body Function Monitoring N=12</td>
<td>1 8</td>
<td>2 16.7</td>
<td>8 66.7</td>
<td>0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>Expert Questionnaire of College Students' Sports Quality Monitoring N=14</td>
<td>3 21.4</td>
<td>4 28.6</td>
<td>6 42.9</td>
<td>1 7.1</td>
<td>0 0</td>
</tr>
<tr>
<td>Expert Questionnaire of Medical Indicators Monitoring of College Students N=14</td>
<td>2 14.3</td>
<td>4 28.6</td>
<td>8 57.1</td>
<td>0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>

In order to ensure the questionnaire survey data genuine and believable, repetition method is
used to test the reliability of the questionnaire. 10 experts who participated in the questionnaire survey were randomly selected, a week after the end of the first round of questionnaire survey, second questionnaires were conducted. The results of the two survey show that the average test-retest reliability coefficient of the questionnaire was 0.93, indicating that the questionnaire had statistical significance.

2.2.4 Analytic Hierarchy Process (AHP)

In this paper, Analytic Hierarchy Process was adopted to calculate the weight of each index. Analytic Hierarchy Process divides the research questions and the factors that are included into it into several levels of interaction according to certain subordinate relationship. Then uses specific mathematical methods to calculate the relative importance degree and the weight value of factors at each level, finally uses the high and low order of weight value to analyze and solve the essence of the problem. The emphasis of this method is the ratio of the factors affecting each other—aji, the value of aij is determined by 1-9 value method of Saaty.\(^{[6-7]}\)

The basic steps of Analytic Hierarchy Process (AHP): (1) Establish hierarchical structure model of AHP. (2) Construct judgment matrix. According to the hierarchical structure model, construct the judgment matrix, these judgments matrices are completed by the relevant experts, so as to further statistics and analysis each index weight. (3) Statistic and process matrix consulted from experts, then use the software of MATLAB to calculate the maximum eigenvalue and the feature vector of the maximum eigenvalue of matrix. (4) Disposable test. (5) Total ordering of Index level.

3 Results and Discussion

3.1 Research results

3.1.1 Construction Principles of Monitoring Indicators of Physical Health Status of College Students

In the construction process of monitoring indicators of physical health status of college students, there are five principles: principle of scientificalness, principle of feasibility, principle of relative integrity, principle of relative independence, principle of comparability.

3.1.2 Content system of Health Status Monitoring of College Students' Physical Fitness

This text makes college students' physical health monitoring index preliminarily constructed into questionnaire, and consults relevant experts and professors, according to experts and professors' views to screen and determine, then construct the content system of health status monitoring of college students' physical fitness, as shown in Table 2.
Table 2. Expert Survey Results about Content System of College Students’ Physical Health.

<table>
<thead>
<tr>
<th>first order index</th>
<th>expert positive rate ( % )</th>
<th>second level index</th>
<th>expert positive rate ( % )</th>
</tr>
</thead>
<tbody>
<tr>
<td>body shape structure</td>
<td>100</td>
<td>index of BMI</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the ratio of chest measurement and height</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>body sebum thickness</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vital capacity weight index</td>
<td>91</td>
</tr>
<tr>
<td>body function</td>
<td>100</td>
<td>stand on one leg with closed eyes</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>steps test</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50m</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td></td>
<td>standing long jump</td>
<td>95</td>
</tr>
<tr>
<td>body quality</td>
<td>100</td>
<td>sit-and-reach</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the power of gripping</td>
<td>98</td>
</tr>
<tr>
<td>medical examination index</td>
<td>100</td>
<td>vision</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dental caries</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hemoglobin concentration</td>
<td>91</td>
</tr>
</tbody>
</table>

3.1.3 The Determination of The Organization Level and Relative Weight of Monitor Control Index of College Students’ Physical Health Status

3.1.3.1 Establish Hierarchical Structure Model of AHP

![Hierarchical Structure of the Proposed Architecture](image)

Figure 1. Hierarchical Structure of the Proposed Architecture.

3.1.3.2 Index Weight Calculation

Statistic and process matrix consulted from experts, then use the software of MATLAB to
calculate the maximum eigenvalue and the feature vector of the maximum eigenvalue of the five matrices, as shown in Table 3, finally, the weight vector (namely weight) of each judgment matrix is obtained. Ranking of weights of each index shown in Table 4. From Table 3 we can see that the consistency check of the five judgement matrices all reached statistical requirements.

Table 3. The maximum eigenvalue and the feature vector of the maximum eigenvalue of each judgment matrix.

<table>
<thead>
<tr>
<th></th>
<th>maximum eigenvalue ($\lambda_{\text{max}}$)</th>
<th>the feature vector of the maximum eigenvalue</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Condition P</td>
<td>4.0968</td>
<td>(-0.4013,-0.6068,-0.6545,-0.2058)</td>
<td>0.032267</td>
</tr>
<tr>
<td>Body Shape M1</td>
<td>3.0092</td>
<td>(-0.8468,-0.4660,-0.2565)</td>
<td>0.0046</td>
</tr>
<tr>
<td>Body Function M2</td>
<td>3.0183</td>
<td>(0.6323,0.2762,0.7238)</td>
<td>0.00915</td>
</tr>
<tr>
<td>Body Quality M3</td>
<td>5.0106</td>
<td>(-0.4709,-0.3295,-0.2535,-0.5706,-0.5289)</td>
<td>0.00265</td>
</tr>
<tr>
<td>Medical Index M4</td>
<td>3.0092</td>
<td>(0.7510,0.2274,0.6199)</td>
<td>0.0046</td>
</tr>
</tbody>
</table>

Table 4. Hierarchical ranking of Health monitoring index of College Students' physical fitness.

<table>
<thead>
<tr>
<th></th>
<th>single ordering weight value</th>
<th>H</th>
<th>single ordering weight value</th>
<th>total ordering weight value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>0.22</td>
<td>H1</td>
<td>0.54</td>
<td>11.88</td>
</tr>
<tr>
<td>M2</td>
<td>0.32</td>
<td>H4</td>
<td>0.39</td>
<td>12.48</td>
</tr>
<tr>
<td>M3</td>
<td>0.35</td>
<td>H7</td>
<td>0.22</td>
<td>7.70</td>
</tr>
<tr>
<td>M4</td>
<td>0.11</td>
<td>H12</td>
<td>0.47</td>
<td>5.17</td>
</tr>
</tbody>
</table>

3.2 Discussion
3.2.1 The Theoretical Basis of the Health Monitoring of College Students' Physique
3.2.1.1 The Definition and Connotation of Health Monitoring of College Students' Physique

In this paper, the general college students' physical health monitoring is defined as: Health monitoring of college students' physical fitness is a whole process, which comprehensive monitor,
analyse and evaluate physical health of college students, and provide students with the appropriate health counseling, regulate and control adverse health factors, so as to achieve the best health effects. There are three aspects of the connotation of the students’ physical health monitoring in ordinary colleges and universities. First, screening, monitoring and analyzing the factors of college students' physical health index, and providing basic data for the evaluation of physical fitness. Second, assessing and managing college students’ physical health status at present and predicting their future physical health trends, better monitoring and controlling the factors influencing college students' physical health. Third, according to the monitoring results, provide students in colleges and universities with health services, such as targeted physical fitness guidance, exercise prescription counseling, etc., so as to achieve the best results of ensuring the physical health of college students.

3.2.1.2 Basic Types of Physical Health Monitoring for Students in Ordinary Colleges and Universities

(1) According to The Relationship Between Monitoring Content and Physical Health

Monitoring system with a single physical health indicators as monitoring content, is chiefly used in longitudinal comparison of subjects or horizontal comparison among several groups. Through the longitudinal comparison of a single individual, can understand the changes of situation about single indicator of individual physical fitness. Through the horizontal comparison between groups, can understand the excellent condition of physical health status of a certain indicator among groups, but can not give groups integrated monitoring. The monitoring of the overall physical health level of the groups general adopt comprehensive monitoring, usually set weight coefficient respectively for each physical health index, then obtain the total score through multiply each index score by its weight coefficient. Finally, arrival at a conclusion by compare the total score of each group with monitoring standard.

(2) According to The Attribute of Monitoring Index

For quantitative indicators, such as height, weight, etc., in the monitoring process usually adopt ratio scale and interval scale to monitor, and for qualitative index, such as index of BMI, hemoglobin concentration, body sebum thickness, etc., need to use hierarchical scale to monitor.

(3) According to monitoring cycle

Determination of monitoring cycle should take the timely reflection of physical health status as premise, according to the difference of types and contents of monitoring indicators, it is usually divided into regular monitoring, long-term continuous monitoring and random monitoring. For key indicators, should adopt regular monitoring. For critical indicator, should adopt long-term continuous monitoring; for not important indicators, usually adopt random monitoring.

3.2.1.3 Basic Characteristics of Health Monitoring of College Students' Physical Fitness

(1) Unity of Integrity and Locality

The integrity mainly refers to health monitoring of college students' physical fitness should take overall monitoring to colleges and universities students, including body shape, physical function, physical quality, as well as medical examination indicators; The locality refers to the subsystem of college students' physical health monitoring, they reflect status of students' physical health from the local, is conducive to the students take self monitoring from the local index of physical fitness.

(2) Unity of Generality and Characteristic

The generality of health monitoring of college students' physical fitness refers to that for students of the same age, the period of growth and development of the body, and the cycle of physical exercise are basically consistent, the standards for their physical health monitoring should
be unified, the monitoring indicators and the monitoring time should also be basically the same. The characteristic of health monitoring of college students' physical fitness refers to that for individual college students, due to the difference of family environment, congenital genetic and other factors, they have their own special, so college students' physical health monitoring should deal with different students in different ways according to the characteristics of individual students on the basis of common. The common characteristic of college students' physical health is conducive to the horizontal comparison between students, so as to predict the development trend of college students' physical fitness accurately. The characteristics of college students' physical health is conducive to meet the needs of individual students, ensure that each student's physical health condition reaches the best level.

(3) Unity of Process and Results

The process of health monitoring of college students' physical fitness refers to that in a certain period of time to monitor health indicators of college students' physical fitness, to understand and master the changes of students' physical health status. The purpose is to monitor the development of students' physical health status, so as to provide corrective diagnosis for the promotion of physical health. The results of health monitoring of College Students' physical fitness refers to that according to the monitoring results diagnose the condition of students' physical health. The purpose is to analyze and find out the reasons of the students' physical health problems.

3.2.2 Connotation and Characteristics of Health Monitoring Indicators of College Students' Physical Fitness

3.2.2.1 The Connotation of Health Monitoring Index of College Students' Physical Fitness

The subsystem of body shape monitoring mainly includes three indicators, such as index of BMI, the ratio of chest measurement and height, body sebum thickness. The index of BMI reflects the development and nutritional status of the human body. The ratio of chest measurement and height is an important indicator, which used in measuring the degree of fat and thin, as well as the symmetry of body. Body sebum thickness refers to that by measuring the thickness of sebum in the body, understand the thickness of subcutaneous fat, then judge the situation of fat and thin of body. It also can be used to speculate the amount of fat in the whole body, evaluate the composition ratio of human body.

The subsystem of body function monitoring consists of three indicators, such as vital capacity weight index, stand on one leg with closed eyes, step test. Vital capacity weight index is the ratio of vital capacity and body weight of the human body, that is, the degree of correlation between vital capacity and body weight was reflected by the relative value of vital capacity per kilogram of body weight; Stand on one leg with closed eyes refers to that close eyes and one foot stand, the other hang in the air, which can reflects body muscle strength and balance ability; Step test index is an important index, which reflects the functional status of cardiovascular system in human body. The greater of the step test index, reflects that the higher of the functional level of the cardiovascular system, on the contrary, the lower of the functional level.

The subsystem of physical quality monitoring includes six indicators, such as 50m Race, standing long jump, sit-and-reach, the power of gripping, 800m Race (female), 1000m Race (male). The 50m Race reflects short distance moving speed of human body; Standing long jump is an important indicator, which used to measure strength and explosive force of lower limbs; Sit-and-reach used to measure the possible range of activities of trunk, waist, hip and other joints in static state, embodies the extensibility and elasticity of these parts, joints, ligaments and muscles,
reflects the development level of physical flexibility. The power of gripping is mainly to test the muscle strength of upper limbs, is an important indicator to measure the development level of power. The 800m Race (female) and the 1000m Race (male) are test of medium and long distance moving ability in human body, is an important indicator to reflect the quality of endurance.

The evaluation contents of medical examination index monitoring subsystem include vision, dental caries and hemoglobin concentration. Vision and dental caries can not only reflect the situation of human development, but also an important factor affecting the development of the human body; Hemoglobin concentration refers to the content of hemoglobin of red blood cells in the whole blood, is an index used to measure anemia.

3.2.2.2 Characteristics of Health Monitoring Indexes of College Students' Physical Fitness

From table 4, we can see that in the first level indicators of health monitoring of college students' physical fitness, the weight of the physical quality index and body function index is 35% and 32% respectively. These two indicators account for a larger proportion in the first level indicator, show that physical fitness and physical function are the core of the health monitoring of college students' physical fitness. In the second level indicators of college students' physical health monitoring, the total sorting weight of index of BMI, vital capacity weight index, step test is 11.88%、12.48%、14.08% respectively. These three indicators are the key point of college students' physical health monitoring. The total sorting weight of the ratio of chest measurement and height, stand on one leg with closed eyes, 50m, standing long jump, the power of gripping, 800m/1000m, vision is 6.6%、5.44%、7.7%、5.25%、9.1%、8.75%、5.17% respectively, which is the key to the health monitoring of college students' physical fitness.

4. Conclusion

College students' physical health monitoring is an activity process, the purpose of which is to carry out the guiding ideology of "health first" in college physical education, promote the implementation of National Students' Physical Health Standard in colleges and universities of China, the related indicators of college students' physical health are analysed and evaluated by research specialist staff, sports related departments and teachers in colleges and universities regulate and control the sports work according to the results of monitoring and evaluation, help students to achieve the best health condition. The main body of the monitoring activity is the research specialist staff and the physical education teacher, the object of the monitoring activity is the university student.

According to different standards, college students' physical health monitoring can be subdivided into different types: 1) According to the difference of the relationship between monitoring content and physical health, it can be divided into a single physical health indicators monitoring and comprehensive physical health indicators monitoring; 2) According to the difference of attribute of physical health monitoring index, it can be divided into quantitative indicators monitoring and qualitative indicators monitoring; 3) According to the difference of physical health monitoring cycle, it can be divided into regular monitoring, random monitoring, long-term continuous monitoring.

On the basis of following the scientific principle, the feasibility principle, the relative integrity principle, the relative independence principle and the comparability principle, the monitoring index system of the physical health condition of college students is established. There are three main characteristics about college students' physical health monitoring: First, unity of integrity and locality; Second, unity of generality and characteristic; Third, unity of process and results. College physical
health status monitoring index system mainly includes four subsystems, such as body shape index monitoring system, body function index monitoring system, sports quality index monitoring system, medical examination index monitoring system.

There are four suggestions should be followed when applying health condition monitoring system of college students' physical fitness. Attention should be paid to the monitoring of the body shape index, and the monitoring of the physical function index. It should take single monitoring to individual indicators, and take integrated monitoring to global indicators. It is not only to monitor the results of physical exercise, but also to monitor the process of physical exercise. Personal characteristics of students should be respected, and longitudinal comparison of students should be emphasized, horizontal contrast between students should be reduced.

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Reference