Research on the Relational Model between Physical Exercise and College Students’ Psychological Quality

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Abstract

At present, colleges and universities pay more and more attention to the comprehensive quality development of students. As a result, physical education takes student development as the core so that through physical exercise it aims to enhance them both mentally and physically. However, in real practice, educators focus only on the sports ability and skills of student but neglect due cultivation of their psychological quality. This study focuses on the relationship between physical exercise and psychological quality, which serves as the reference for college physical educators to improve the psychological education of their students.

Keywords: Physical Exercise, Psychological Quality, Relational Model.

1. RESEARCH REVIEW

1.1 Research background

With the continuous development of society, the requirements for the comprehensive quality of student have risen so that people have paid increasing attention to the relationship between physical exercise and psychological quality (Zou and Mu, 2016). In college physical education, it is a general consensus for physical educators that physical exercise has a positive effect on the psychological quality of student. Meanwhile, colleges and universities have attached importance to the development of students’ psychological quality. Therefore, new demands for physical education have been brought forward, such as the acquisition of better psychological quality in physical exercise. With a good psychological quality, students are able to deal with pressure and get progress in the future work and life (Zhang, 2014).

1.2 Literature review

Colleges and universities should set up psychological health courses. Through the combination with physical education, the purpose of improving the psychological quality of student can be achieved. At the same time, frustration education should be carried out in physical education in which students receive due respect so that they can develop a strong, brave and positive will in frustration (Li, 2008). Physical educators should be improved by further education so that they are willing to pay enough attention to the psychological quality of student in physical education, extend the practice of physical education and optimize their teaching methods. Corresponding questionnaires can be developed for psychological research so as to strengthen students’ psychological quality in physical exercise (Liu, 2012). The construction of sports infrastructure in college and university should be enhanced to ensure the quality of students’ physical exercise. Physical activities of student should be studied while their frequency of exercise has been recorded by the “clock in” system. Publicity of physical exercise such as its significance has to be promoted so as to stimulate students’ motivation of doing sports and then improve their comprehensive mental quality (Wang, 2016). The psychological quality development in physical exercise has grown from nothing, marking an important breakthrough in the physical education in China. The outline of physical education is in the state of continuous refinement. With the development of the outline, the cultivation of psychological quality will be increasingly important and even the main goal of physical education (Wu, 2011).

2. INDEX WEIGHT ALLOCATION OF PHYSICAL EDUCATION EVALUATION SYSTEM IN COLLEGE AND UNIVERSITY
2.1 Hierarchical analysis steps

The index weight allocation of physical education evaluation system in college and university includes the following steps:

Firstly, a sound evaluation system should be established. Through extensive research, influential indicators can be obtained while the relationship between them should be clarified (Cai, 2014).

Secondly, a hierarchical model should be set up. Through the interviews with relevant teachers and experts, the pyramid-shaped results can fall in different layers.

Moreover, a judgment matrix should be established. Through classification and comparison of different influential indicators, their degree of importance can be judged and serves to build a judgment matrix (Wang, 2014).

According to the above steps, the following formula is obtained after the comparison and evaluation of factors that affect the quality of college physical education:

\[
A = \begin{bmatrix}
a_{11} & a_{12} & \cdots & a_{1n} \\
a_{21} & a_{22} & \cdots & a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
a_{n1} & a_{n2} & \cdots & a_{nn}
\end{bmatrix}
\]

The matrix in the hierarchical analysis should meet the following requirements:

1. \( a_{ij} = 1 \)
2. \( a_{ij} = a_{ji} \) for \( i, j = 1, 2, 3, \ldots, n \)

Finally, the matrix should be calculated by a normalized way and put into the formula so as to get the weight coefficient.

The consistency test of the evaluation matrix of college physical education: each index should be compared and put into the matrix. Its maximum eigenvector should be calculated while the consistency test should be carried out (Bao, 2014). If the test is successful, it is proved that the vector is the weight vector. If the test is unsuccessful, reconstruction and then comparison should be conducted. It is assumed that the maximum eigenvalue is \( \lambda_{\text{max}} \) so that the formula is \( \text{CR} = \frac{CI}{CR} \) where CR represents the consistency ratio and CI represents the consistency index. The formula is as follows:

\[
CI = \frac{\lambda_{\text{max}} - n}{n-1}, \lambda_{\text{max}} = \frac{1}{n} \sum_i (Aw)_i = \frac{1}{n} \sum_i (Wv)_i (1)
\]

Then, \( Aw \) represents the product of the matrix and the eigenvector while \( RI \) represents the average random consistency index. The values of RI are shown in Table 1:

<table>
<thead>
<tr>
<th>Order number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
<td>1.52</td>
<td>1.54</td>
</tr>
</tbody>
</table>

When CR<0.1, it can be proved that the matrix is consistent with the evaluation index of college physical education and the resulting weight has a greater impact on college physical education. And if CR>0.1, readjustment to the matrix is needed until it is consisted with the evaluation index.
2.2 Weight calculation of physical education evaluation system in college and university

According to the values of RI in Table 1, the two-level index judgment matrix is shown in Table 2:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1</td>
<td>1/3</td>
<td>1</td>
<td>1/5</td>
<td>1/5</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1/3</td>
<td>1/3</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>1</td>
<td>1/3</td>
<td>1</td>
<td>1/5</td>
<td>1/3</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Then the consistency check of the matrix should be conducted. Firstly, the value of λ should be obtained and put into the following formula: (Meng, 2014)

\[
CI = \frac{\lambda - n}{n-1} \tag{2}
\]

Then the value of CI should be put into the formula \( CR = \frac{CI}{CR} \), where the values of RI are shown in Table 2. When \( CR < 0.1 \), it can be proved that the matrix is consistent with the evaluation index of college physical education and the resulting weight has a greater impact on college physical education. And if \( CR > 0.1 \), readjustment to the matrix is needed until it is consist with the evaluation index. (Tian, 2015)

If the index weight of the evaluation of college physical education is presented by \( W_n \), the following formula is obtained:

\[
W_1 = \sqrt{\frac{1}{3} \times \frac{1}{5} \times \frac{1}{5}} = 0.42 \quad W_2 = \sqrt{3 \times 1 \times 3 \times \frac{1}{3} \times \frac{1}{3}} = 1
\]

\[
W_3 = \sqrt{\frac{1}{3} \times \frac{1}{5} \times \frac{1}{5} \times \frac{1}{5}} = 0.42 \quad W_4 = \sqrt[5]{3 \times 3 \times 5 \times 1 \times 1} = 2.37
\]

\[
W_5 = \sqrt[5]{3 \times 3 \times 5 \times 1 \times 1} = 2.37 \sum W_i a = 0.06 + 0.16 + 0.06 + 0.36 + 0.36 = 6.58 \tag{3}
\]

Through the normalization of \( W_n \), the study finds:

\[
W_1 = 0.42 + 6.58 = 0.06W_2 = 1 + 6.58 = 0.15W_3 = 0.42 + 6.58 = 0.06
\]

\[
W_4 = 2.37 + 6.58 = 0.36W_5 = 2.37 + 6.58 = 0.36
\]

According to the above calculation, the weight ratio of each index can be obtained.

2.3 Cloud model of college physical education evaluation index

Cloud theory is an upgrading of the traditional membership function, which can convert data between qualitative and quantitative ones by applying language values so as to solve the problems of their conversion. So with the ambiguity of the original concept, the mining of information and data can be conducted to get corresponding conclusions. Samples of N quantity are applied in the cloud model. The formula is:

\[
E_x = \frac{E_{x_1} + E_{x_2} + \ldots + E_{x_n}}{n}
\]
\[ E_n = \max (E_{x_1} + E_{x_2} + \cdots + E_{x_n}) - \min (E_{x_1} + E_{x_2} + \cdots + E_{x_n}) \]  

(4)

2.3.1 Mathematical model of principal component

\[ F_1 = a_{11}x_1 + a_{21}x_2 + \cdots + a_{p1}x_p \]

\[ F_2 = a_{12}x_1 + a_{22}x_2 + \cdots + a_{p2}x_p \]

\[ F_i = a_{1m}x_1 + a_{2m}x_2 + \cdots + a_{pm}x_p \]

2.3.2 Principal component analysis

After obtaining the mathematical model of principal component, the weight is calculated through principal component analysis. Firstly, a synthesizing evaluable function is set up. Then according to the contribution rate of each influencing factor, indicators of s quantity with the highest contribution rate are selected. And then their principal components are determined as \( F_1, F_2, \ldots, F_s \). Their contribution rate should be over 90% (Ding and Shen, 2015). The synthesizing evaluable function of principal component is as follows:

\[ F = h_1F_1 + h_2F_2 + \cdots + h_sF_s \]

(5)

Through calculation, parameters \( s, x_{(i-1, 2, 3, \ldots, p)} \) are obtained. The absolute values of these parameters are weights influential to the index. Through normalization, the weight of each index can be obtained.

2.3.3 Weighting deviation to check the change of cloud focus

Under ideal condition, all index values are clear where the cloud focus should be: \( a = (E_{x_10}, E_{x_20}, \ldots, E_{x_p0}) \) with its vector height as \( b = (b_1, b_2, \ldots, b_p) \). So the integrated cloud focus vector is \( T^0 = a \times b^T = (T^0_1, T^0_2, \ldots, T^0_p) \). Meanwhile, under non-ideal condition, the integrated cloud focus vector is:

\[ T = (T_1, T_2, \ldots, T_p) \]

Under non-ideal condition, the normalization computing of integrated cloud focus vector results in

\[ T^G + (T^G_1, T^G_2, \ldots, T^G_p) \]

then:

\[ T^G_i \begin{cases} \frac{T_i - T^0_i}{T^0_i} & T_i < T^0_i \\ \frac{T_i - T^0_i}{T^0_i} & T_i \geq T^0_i \end{cases} \]

(6)

Multiply the normalized results with the influential weights of index. Their products are between 0 and 1. The formula is:

\[ \theta = \sum_{i=1}^{p} W_j \times T^G_j \]

(7)

\( W_j \) represents the Jth weighted value.

3. THE SURVEY OF STUDENTS’ OVERALL MENTAL HEALTH STATUS

Mental health problems do not equal to mental illness but hidden problems in psychological aspect. If the problems can be resolved, psychological problems will be settled and students will return to normal status and be ready for future study and life. Otherwise, it is possible to result in unhealthy psychological status (Jia, 2015). A survey of the overall mental health status of student enrolled in 2014, 2015 and 2016 by questionnaire has been
conducted and its results are shown in Table 3:

**Table 3** Students’ overall mental health status before the experiment

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>A class</td>
<td>6%</td>
<td>8%</td>
<td>11%</td>
</tr>
<tr>
<td>B class</td>
<td>22%</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>c class</td>
<td>72%</td>
<td>72%</td>
<td>64%</td>
</tr>
</tbody>
</table>

The statistical result shows that 6% students enrolled in 2014 have serious mental health problems while 22% of them have a hidden danger. 72% of them are comparatively healthy in this aspect. Compared with them, 8% students enrolled in 2015 fall in the first category, 20% in the second and 72% in the third. For, those enrolled in 2016, 11% fall in the first category, 25% in the second and only 64% in the third. Students without mental health problem decreases year by year while those with certain serious psychological problems continue to increase, which shows that the psychological health of college students doesn’t seem optimistic and should be attached importance to. After physical exercise of one semester, the mental health status of students is shown in Table 4:

**Table 4** Students’ overall mental health status after the experiment

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>A class</td>
<td>4.3%</td>
<td>5%</td>
<td>5.4%</td>
</tr>
<tr>
<td>B class</td>
<td>15.6%</td>
<td>16.5%</td>
<td>14%</td>
</tr>
<tr>
<td>c class</td>
<td>80.1%</td>
<td>78.5%</td>
<td>80.6%</td>
</tr>
</tbody>
</table>

The statistical result shows that students’ mental health problems have decreased, showing a different degree of decline. Among them, problems of students enrolled in 2006 show the highest proportion of decline. A conclusion that physical exercise is indeed conducive to students’ psychological quality and alleviation of their mental health problems can be drawn.

3.1 Emotional swing factors of college student

Emotional swing factors of college student are shown in Table 5:

**Table 5** The Main Emotional Swing Factors of College Students

<table>
<thead>
<tr>
<th>project</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mood swings</td>
<td>boy</td>
<td>girl</td>
<td>boy</td>
</tr>
<tr>
<td>anxious</td>
<td>42</td>
<td>31</td>
<td>41</td>
</tr>
<tr>
<td>Temper</td>
<td>18</td>
<td>35</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>32.1</td>
<td>33.4</td>
<td>35.1</td>
</tr>
</tbody>
</table>

According to Table 5, for male students enrolled in 2005, the ones with serious emotional swings, anxiety or even irritability account for 42%, 18% and 34% respectively. For female students enrolled in 2005, the three types take up 31%, 35% and 35% respectively. For male students enrolled in 2006, the three types take up 40%, 24% and 20% respectively. For their counterpart, the three types take up 36%, 21% and 30% respectively. Since college students are faced with an important period for view of life and value development, deviation of self-cognition, negative emotion and temper loss are common problems, which are called “psychological weaning period” in psychology. During this period, mental health factors are most influential to students. After physical exercise of one semester, the main factors of their emotional swings are shown in Table 6:

**Table 6** Major Emotional Swings in College Students After Exercise

<table>
<thead>
<tr>
<th>project</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mood swings</td>
<td>boy</td>
<td>girl</td>
<td>boy</td>
</tr>
<tr>
<td>35</td>
<td>20</td>
<td>31</td>
<td>27</td>
</tr>
</tbody>
</table>
With the comparison of Table 5 and Table 6, the author finds that after physical exercise, students in three grades have been relieved from emotional swings, anxiety and irritability. Since students can get negative emotions off their chest in physical exercise, physical exercise plays an important role in solving psychological problems and enhancing their psychological quality.

3.2 Students' communication disorders

Students’ communication disorders are shown in Table 7.

<table>
<thead>
<tr>
<th>project</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>want to die</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>boy</td>
<td>2</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>girl</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hate intercourse</td>
<td>7</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Despise Yourself</td>
<td>16</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>

According to Table 7, among male students enrolled in 2014, those with suicidal tendency, hatred of social contact and feelings of being neglected account for 2%, 7% and 16% respectively. For female students in the same grade, the figures are 1%, 5% and 17% respectively. Among the male students enrolled in 2015, the figures are 3%, 4% and 17% respectively. For female students in the same grade, the figures are 2%, 6% and 20% respectively. Among male students enrolled in 2014, the figures are 1%, 7% and 18% respectively. For female students in the same grade, the figures are 2%, 4% and 15% respectively (Wang and Xie, 2009).

College students are now characterized with strong self-esteem. They think highly of themselves and attach importance to interpersonal relationship which is one of the vital issues for them. A bad interpersonal relationship will have a negative impact on not only study and living but also their future development (Zhang, 2015). After physical exercise of one semester, their situations are shown in Table 8:

<table>
<thead>
<tr>
<th>project</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>want to die</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>boy</td>
<td>0.3</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td>girl</td>
<td>0</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Hate intercourse</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Despise Yourself</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

According to Table 8, students with suicidal tendency in each grade has declined, especially female students enrolled in 2014 whose rate is 0%. Concerning social contact, many students have met new friends through physical exercise, which eases the hatred of social contact. After physical exercise of one year, the majority has become more confident and thinks less of being neglected, which shows a great improvement of their comprehensive psychological quality (Dong et al., 2006).

4. CONCLUSIONS

4.1 At present, due to a variety of subjective or objective factors, many college students in China have some mental health problems. They may not be obvious but very important hidden dangers which will break out and affect students’ work and life when they encounter setbacks or difficulties in the future. Therefore, colleges and
universities should pay enough attention to their mental health problems. They should reduce students' mental health problems and promote their comprehensive development by strengthening physical exercise.

4.2 Physical education should combine with mental health education. Experiments show that physical exercise plays an important role in solving the students' mental health problems. However, in traditional teaching mode, lack of due attention and method of mental health education has led to its poor effect on promoting mental health education and easing negative psychological status. Therefore, college physical educators should pay attention to mental health education in physical education.

4.3 Frustration education plays an important role in cultivating students' willpower. Nowadays, college students, as the only child, have led a comfortable life and experienced few difficulty and setback from childhood so that they are not equipped with a strong will. Therefore, in physical exercise, teachers should give students enough difficulties such as some complicated movements that students develop their willpower and improve their psychological quality in such frustration education.

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