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Optimal principle-based psychological health and physical exercise time standard research

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ABSTRACT

Physical exercise plays a very important role in promoting psychological health, people that often take sports exercises have higher psychological quality and their psychological health status are also relatively good. Research on physical exercise is beneficial to improve Chinese masses psychological health level, and better avoid occurrence of psychological barriers. The paper makes use of SPSS software to make quantitative analysis of physical exercise and psychological health status relations, and on this basis, it utilizes goal programming method and discriminant analysis to establish optimal principle-based psychological health development and physical exercise standard model, by analyzing statistical data, it gets optimal solution and physical exercise time standard that are beneficial to psychological health development, which is taking above 0.5 hours physical exercises play a remarkable role in improving psychological health level, and keeping exercising for above 1.5 hours every day is the best choice to maintain relative health psychological status. In addition, on this basis, it makes comprehensive evaluation on physical exercises and psychological health status influence factors, so that provides theoretical support for above analysis.

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KEYWORDS

Physical exercises standard;
Psychological health;
Optimal principle;
Goal programming;
Discriminant analysis.

INTRODUCTION

Nowadays, social economy are rapidly developing, lots of people have certain psychological barriers due to life and work pressures, while the serious one also suffers anxiety, depression and other psychological diseases. In general, medically common chemicals curative effects on these psychological diseases are not good, while physical exercise overcomes such drawback. Numerous scholars have being constantly studied on the problem for years.

In the article "Discuss social psychology of sports research contents", Liu Zhou-Min took social psychology of sports as research key point, by exploring its contents, analyzing sports science psychological issues, and further presented conclusion: sports science, sociology and psychology had necessary relations, physical exercise had important impacts on psychological quality improvement and psychological health status. In social life, both sports and psychology occupied certain positions.

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In the article "Primary and secondary school students' sports psychological health educational functions and their practice strategies research", Zang De-Xi started from secondary school students' sports perspective, analyzed secondary school students current sports education, and pointed out that psychological health education was one of important part in secondary school students' development and education, its educational function couldn't be neglected. In addition, in secondary school students' psychological health education, it should focus on giving physical exercise into play, combine with specific practice, and then further better promote secondary school students' development. In the article "University students' physical exercise participation and psychological health relations research", Shi Wen-Yan combined with lots of previous research conclusions, took university students as research objects, used questionnaire survey and other forms to make statistics of university students' physical exercise status and psychological status, and analyzed results, she got that contemporary students spent less time in physical exercising, and there were bigger differences in gender, female students' physical exercises were relative fewer, which impacted on university students' psychological health development to some extent.

The paper combines with scholars research results, utilizes mathematical methods, establishes psychological health development and physical exercise standard mathematical model, and further researches on physical exercise and psychological status relationships, and defines best physical exercise time that is beneficial to psychological health.

MODEL ESTABLISHMENTS

Physical exercise to psychological health influences comprehensive analysis

Physical exercise is a good habit; it has important impacts on students' psychological health and psychological quality. However, presently affected by academic record, Chinese students' physical exercises status is not good and female students are especially affected.

Below TABLE 1 is Chinese student physical exercise habit statistical table, data is from national students' physique and health investigation result notice and general administration of sport of China.

Draw above statistical table into following statistical Figure 1, and make analysis:

By SPSS software, it analyzes correlation and gets following correlation TABLE 2:

Above statistical figure and correlation table show: with exercise time difference, psychological status is also

TABLE 1: Different exercises habits to psychological health influence status

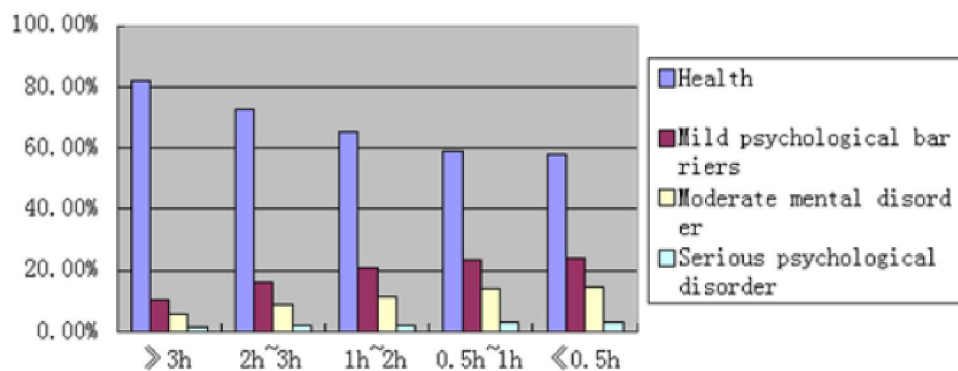| Exercise time h/day	Health	Mild psychological barriers	Moderate mental disorder	Serious psychological disorder
》 3h	82.3%	10.53%	5.74%	1.43%
2h~3h	72.58%	16.07%	9.14%	2.22%
1h~2h	65.22%	20.98%	11.54%	2.26%
0.5h~1h	59.13%	23.63%	14.19%	3.05%
《 0.5h	58.12%	23.97%	14.58%	3.33%

Figure 1: Physical exercise time relationship with mental health

TABLE 2 : Correlation

	Psychological barrier extent	Health	Mild	Moderate	Serious
Pearson correlation	Exercise time h/day	.981	-.974	-.985	-.949
Sig. (Unilateral)	Exercise time h/day	.002	.003	.001	.007

different, long exercise time has better psychological status and occurrence of psychological barrier probability is small, while less exercise time, the corresponding health index is also low, serious psychological disorder occurrence probability is also high. Therefore, physical exercise has very important impacts on psychological health.

Optimal solution model-based physical exercise to psychological health influence research

Goal programming guiding thought

As the name suggests, goal programming is programming all given systematical problems by mathematical methods and further getting a group of optimal schemes of practice expected goal. Goal programming overcomes linear programming constraints that only solve a group of linear constraint conditions. In addition, to certain goals, they should have primary and secondary ones, and also mutual complementation and mutual antagonism. Meanwhile, there is also maximum value, minimum value as well as a difference of quantitative and qualitative, LP cannot solve these problems, while goal programming just overcomes the drawback.

Generally, goal programming has three kinds of methods, weighted coefficient method, priority method and effective solution method. Among them, weighted coefficient method is defining a weight on every solved goal, and further converting complicated multiple goals problems into single goal problems, but its weight rationality is hard to set; priority method is to classify each goal into different grades, its classification evidence is each goal importance. Effective solution can take all goals into account and further get most satisfied solution.

Goal programming objective function common basic form is:

(1) Try to make positive and negative deviation small, and then further just arrive at goal value:

$$\min z = f(d^+ + d^-)$$

Try to make positive deviation small, no need to arrive at goal value

$$\min z = f(d^+)$$

Try to make negative deviation small, surpass goal value and surpass quantity is not limited

$$\min z = f(d^-)$$

Among them, positive and negative deviation variables definitions are as following:

Known that d is decision variable function, positive deviation variable $d^+ = \max\{d - d_0, 0\}$ represents the part that calculation value surpasses goal regulated value, negative deviation variable $d^- = -\min\{d - d_0, 0\}$ represents the part that calculation value less than goal regulated value, and d_0 is is d goal regulated value, it always has $d^+ \times d^- = 0$.

Priority factor: $P_1, P_2, \cdots$, and it has $P_k \gg P_{k+1}, k = 1,1,\cdots,q$, which represents P_k has bigger priority than P_{k+1}.

Goal programming normal mathematical model

Known $x_j (j = 1,2,\cdots,n)$ is goal programming decision variable, it totally has m pieces of constraints, and l pieces of weak goal constraints, its goal programming constraint deviations are d^+, $d_i^- (i = 1,2,\cdots,l)$. Set that it has q pieces of priorities that are respectively $P_1, P_2, P_3, \cdots, P_q$. In the same priority P_k, weights are different that are respectively ω_{kj}^+, $\omega_{kj}^- (j = 1,2,\cdots,l)$. Therefore goal programming normal mathematical expression is:

$$\min z = \sum_{k=1}^{q} P_k \left(\sum_{j=1}^{l} \omega^-_{kj} d^-_j + \omega^+_{kj} d^+_j \right)$$

$$\begin{cases} \sum_{j=1}^{n} a_{ij} x_j \leq (=,\geq) b_i, i = 1,\cdots,m \\ \sum_{j=1}^{n} c_{ij} x_j + d_i^- - d_i^+ = g_i, i = 1,\cdots,l \\ x_j \geq 0, j = 1,2,\cdots,n \\ d_i^-, d_i^+ \geq 0, i = 1,2,\cdots,l \end{cases}$$

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Goal programming data processing

According to above goal programming guiding thought, make data processing with different exercise habits to psychological health influence status data, it adopts sequential algorithm here. Sequential algorithm is according to factors importance, decomposing complicated multiple goals programming problems, and further changing into multiple simple goal programming problems, its main process is as following:

To $k = 1, 2 \cdots, q$, solve

$$\min z = \sum_{j=1}^{1} P_k \left(\sum_{j=1}^{1} \omega^-_{kj} d_j^- + \omega^+_{kj} d_j^+ \right) \qquad (1)$$

$$\sum_{j=1}^{n} a_{ij} x_j \leq (=, \geq) b_i, i = 1, \cdots, m \qquad (2)$$

$$\sum_{j=1}^{n} c_{ij} x_j + d_i^- - d_i^+ = g_i, i = 1, \cdots, l \qquad (3)$$

$$\sum_{j=1}^{1} \left(\omega^-_{sj} d_j^- + \omega^+_{sj} d_j^+ \right) \leq z_s^*, s = 1, 2, \cdots, k-1 \qquad (4)$$

$$x_j \geq 0, j = 1, 2, \cdots, n \qquad (5)$$

$$d_i^-, d_i^+ \geq 0, i = 1, 2, \cdots, l \qquad (6)$$

Among them, optimal value is z_k^*

At first, most important is psychological health status, therefore its priority ranks the first grade P_1; secondly, psychological health status suffers work and learning pressure influences that is the second grade P_2; whether psychology is health or not that is also affected by life style, it is the third grade P_3; Finally, traditional cultural awareness will also impact on psychological health, it is the fourth grade P_4. It requires that psychological health percentage should be above 65%. Therefore, it gets corresponding goal programming model:

$$\min z = P_1 d_1^- + P_2 (d_2^+ + d_2^-) + P_3$$

$$(3d_3^+ + 3d_3^- + d_4^+) + P_4 (3d_4^+ + 3d_4^- + d_5^+)$$

$$82.30x_1 + 10.53x_2 + 5.74x_3 + 1.43x_4 = 3$$

$$72.58x_1 + 16.07x_2 + 9.14x_3 + 2.22x_4 = 2.5$$

$$65.22x_1 + 20.98x_2 + 11.54x_3 + 2.26x_4 = 1.5$$

$$59.13x_1 + 23.63x_2 + 14.19x_3 + 3.05x_4 = 0.75$$

$$58.12x_1 + 23.97x_2 + 14.58x_3 + 3.33x_4 = 0.5$$

$$x_1, x_2, \cdots, x_i, d_i^+, d_i^- \geq 0, i = 1, 2, \cdots, 4$$

Calculate above objective function by MATLAB software, and further get goal programming optimal solution is: $z^* = (1, 2, 3)$, and psychological health percentage is 69.8%.

Result analysis

From above objective function optimal solution, it can get conclusion: take physical exercise at least above 0.5 hours per day has remarkable effects on improving psychological health level. To further define physical exercise standard that is beneficial to psychological health development, use discriminant analysis to make further research on above data statistical table.

Discriminant analysis method-based promoting psychological health development physical exercise standard research

Above optimal solution model analyzes physical exercise impacts on psychological health, and points out that above 0.5 hours physical exercise has remarkable effects on psychological health level improvement. On this basis, utilize discriminant analysis method to define optimal physical exercise time that is beneficial to psychological health development.

Model preparation

Discriminant analysis is a kind of multiple statistical analysis method, it refers to observe known evaluation indicators, and according to observed data, it makes classification on evaluation objects. Discriminant analysis general steps are as following Figure 2:

Establish discriminant analysis model

Bayes discriminant analysis is a method that analyzing two kinds or various kinds of data, here, juvenile volleyball athletes' sports quality criterion should be analyzed according to their age and gender, so use Bayes discriminant analysis is most suitable.

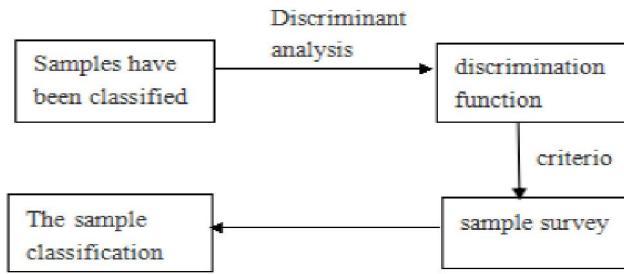Under above discriminant criterion, established classified function form is:

Figure 2 : Discriminant analysis step

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

That is establishing linear function equation set between observed indicators and observed objects, every equation set corresponds to a kind of discriminant criterion, from which $c_{0j}, c_{1j}, \cdots, c_{pj}, j = 1,2,\cdots,n$ is estimation parameter. After establishing discriminant function, input one discriminant object each parameter value into above discriminant function, then it can know which type the object belongs to.

According to above data, make data processing, and establish Bayes discriminant analysis classified function equation set, and further define physical exercise time standard that is beneficial to psychological health development.

Establish Bayes discriminant analysis classification function

(1) Handle with data

Use SPSS software to analyze TABLE 1 data, then

TABLE 3 : Coefficient table

Model	Non-standard coefficient		Standard coefficient		
	B	Standard error	Trial version	t	Sig.
(Constant)	3.659	1.334		2.742	.223
Health	.415	.521	2.117	.998	.685
Mild psychological barrier	.390	.423	2.054	.923	.525
Moderate mental disorder	-1.161	.929	-3.949	-1.249	.430
Serious psychological disorder	1.374	1.539	.954	.893	.536

it can get as following TABLE 3 classification function regarding physical exercise time and psychological health status:

According to above coefficient TABLE 3, it can get physical exercise time standard classification function that is beneficial to psychological health development:

$$y = 0.998x_1 + 0.923x_2 - 1.249x_3 + 893x_4 + 2.742$$

Among them, y is physical exercise time, x_1 is health, x_2 is mild psychological barrier, x_3 is moderate mental disorder, x_4 is serious psychological disorder.

Improved discriminant analysis classification function

In order to improve discriminant accuracy, make improvement on above Bayes discriminant analysis classification function equation set. Bayes discriminant analysis classification function changes as following form:

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

In physical exercise time and psychological health research, $q(y) = 0.55$.

On the basis of considering prior probability, it can further get physical exercise time standard Bayes classification function that is beneficial to psychological health development as following:

$$y = 0.998x_1 + 0.923x_2 - 1.249x_3 + 893x_4 + 2.742 + \ln(0.55)$$

That:

$$y = 0.998x_1 + 0.923x_2 - 1.249x_3 + 893x_4 + 2.144$$

Above is physical exercise time standard discriminant function that is beneficial to psychological health development.

Define classification criterion

According to goal programming conclusion, and physical exercise as well as psychological health status correlation analysis, now define following physical exercise time criterion:

Health psychology: Physical exercise time $\gg$ 3.5 hours/ day

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Good psychology:Physical exercise time is 1.5~ 3.5 hours/ day

Mild psychological barrier:Physical exercise time is 1~1.5 hours/ day

Moderate mental disorder:Physical exercise time is 0.5~1 hours/ day

Serious psychological disorder:Physical exercise time is 0 hours/ day that is never taking exercise

Above standard is the standard that uses physical exercise time to define psychological health status. By above standard analysis, it gets: Psychological health is strongly correlated with physical exercise, normally people that averagely take above 1.5 hours physical exercise every day have good psychological health status. Therefore, to promote psychological health development, it should insist on physical exercise, at least should keep 1.5 hours per day.

Physical exercise and psychological health influence factors comprehensive analysis

Understanding degree on psychological health

Current masses psychological health understanding is an important factor that affects current psychological health development. Therefore, now make statistics of Chinese masses understanding degrees on psychological health, data is from national physique and health investigation result notice and internet correlation investigation. Draw data into following statistical Figure 3, and analyze conclusion:
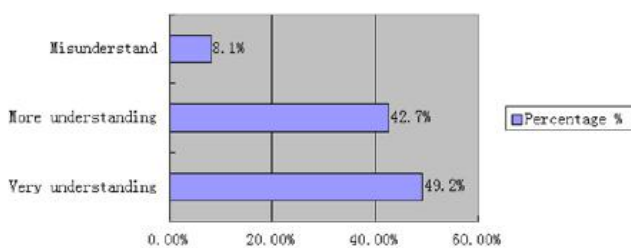

Figure 3 : To understand the mental health of students in China

Above Figure 3 shows: Chinese masses understanding degree on psychological health is normal, fully understand psychological health effects only occupies 49.2%, normal understanding degree occupies 42.7%, and it still has 8.1% masses don't understand. Therefore, it should strengthen sports psychological health education and publicity, and further improve psychological health position in the heart of masses.

Physical exercise functions understanding

Physical exercise functions are various; it not only can build one's body, but also can promote psychological health development, and improve one's social adaptability. Below Figure 4 is people's cognition comparison figure about physical exercise numerous functions importance, data is from international general administration of sport, Chinese statistical yearbook and so on.
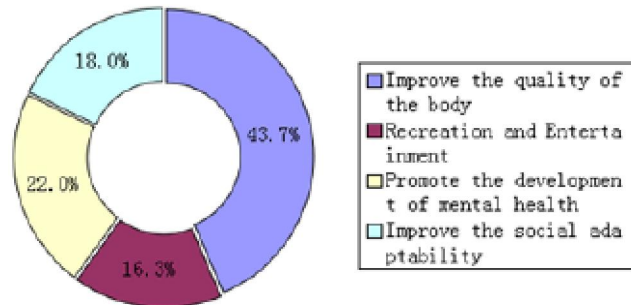

Figure 4 : The motivation of physical education and health class

TABLE 4 : Physical exercise time as well as study and work time statistical table

	Boy students	Girl students
Physical exercise time	62.20%	37.80%
Study and work time	43.61%	56.39%

From above pie Figure 4, it draws a conclusion: For physical exercise, body building, improves quality of body are still its main functions. In addition, promote the development of mental health also occupies big proportion in physical exercise main functions. Therefore, it is clear that physical exercise has effects on promoting psychological health; most of people have higher cognition on it.

Physical exercise time allocation

For physical exercise, its time allocation occupied proportion in daily learning and work is very important, especially for boy students and girl students, physical exercise habits are different from each other. Below table is physical exercise time as well as study and work time statistical table, data is from national students' physique and health investigation and survey results notice and general administration of sport of China.

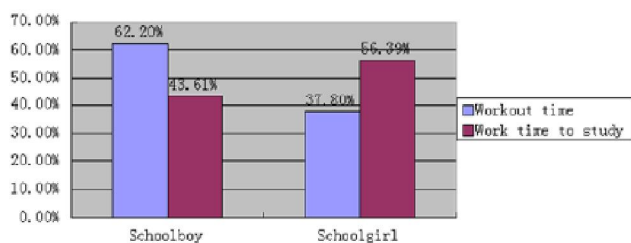Draw above TABLE 4 into following statistical Figure 5, and analyze conclusion:

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Figure 5 : Physical exercise habits

Above bar statistical figure shows that Chinese physical exercise status has great differences between men and women, and its proportion is smaller than study and work time by comparing. It affects physical exercise impact on masses life to some extent.

CONCLUSION

Firstly, the paper analyzes physical exercise and psychological health status relations, and uses SPSS software to quantitative analyze the two correlations. On this basis, it utilizes goal programming method to analyze physical exercise time and psychological health status statistical data, it gets optimal solution that is beneficial to psychological health development, and further draws a conclusion: physical exercise and psychological health development are closely connected, take above 0.5 hours physical exercise has remarkable effects on psychological health level improvement.

Secondly, the paper utilizes discriminant analysis method, establishes physical exercise time standard discriminant function regarding psychological health development promotion, and according to discriminant criterion, it gets physical exercise time standard that is beneficial to psychological health development: Averagely take above 1.5 hours exercise every day is most beneficial to psychological health.

On the basis of physical exercise time standard quantitative analysis, combine with factors that affect physical exercise and psychological health status, make comprehensive evaluation, and further provide theoretical basis for above analysis.

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