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Research on the effects of aerobics on promoting the psychological development of students based on SPSS statistical analysis

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ABSTRACT

As a sport done under musical rhythms, aerobics plays a positive role in shape molding and temperament improvement of sporters. Good mental health serves as the guarantee of college students' study and life. This paper conducts course design for 100 students attending aerobics courses and explores the differences between students' early psychological factors and later ones in a view to putting forward a more effective way to raise the mental health level of college students. This paper firstly designs the course goal, course content, training frequency and training form of aerobics in universities, providing a basis for the research on the extent to which aerobics promotes the mental health of college students. Then it explains the principle and operation steps of independent-samples T-test in detail. This paper focuses on the differences between students' early psychological factors and later ones. As t *and* P *value resulting from T-test are important statistical parameters that reflect such difference, it provides a theoretical basis on the extent to which aerobics promotes the mental health of students. A questionnaire for SCL-90 scale is designed. The questionnaire data compares and analyzes students' early psychological factors with later ones and the improvement effect of each psychological factor after aerobics training is obtained. The conclusion that all psychological factors including F-interpersonal relationship, D-compulsion, H-depression, C-paranoid, I-anxiety, G-hostility, B-somatization, A-psychoticism and E-phobia show an index-declining trend is drawn.*

Key words: Mental health level; national norm; psychological factor; SCL-90 scale; independent-samples t-test

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INTRODUCTION

With respect to measuring the ideal level of people's qualities, mental health is one of the most important criteria. Contemporary college students need not only healthy body but also healthy psychology. This paper studies the early and later psychological factors of students attending aerobics course and explores the extent to which aerobics promotes the mental health of college students.

Great efforts have been made to study the extent to which sports promotes people's mental health. It is these efforts made by the following researchers that help those suffering from psychological sub-health relieve reasonably. Among these researchers, Chen Lihua *et al* use the more mature Self-rated Health Measurement Scale（SRHMS）formulated by experts to conduct a tracking survey on the mental health conditions of college students in Fujian province[1]. They find out the situation of how the mental health of college students could be improved through aerobics teaching. Wang Dandan *et al* employ the documentation method, questionnaire survey method, interview method and mathematical statistical method to investigate the mental health of 215 skiers. They arrive at the conclusion that Alpine skiing plays a role in improving the mental health of skiers and serves to reduce people's anxiety and depression and improve their interpersonal relationship [2]. Yang Xinhai *et al* summarize the relationship between physical exercise and exercise prescription pertaining to subjective well-being, depression, anxiety, stress, mental status, self-esteem and mental health effect and look forward to the future research in this area [3].

Based on previous studies, this paper focuses on nine psychological factors of 100 students attending aerobics course of a certain university and investigates the differences between students' mental health at early training and their mental health at later training. It draws the conclusion that aerobics has significant effects on promoting the mental health of college students.

2. RESEARCH OBJECTS AND METHODS

2.1 Research objects

With 100 college students (35 male students, 65 female students) of a certain university attending the public PE aerobics being the research object, the SCL-90 scale is used to compare students' psychological factors in the early stage of the aerobics course with the national norm. The result is shown in table 1.

Tab. 1: Comparison result of students' psychological factors in the early stage of the aerobics course with the national norm SCL-90 scale

Psychological factors	National norm（N=820）	Early learners（N=100）	t	P
	$x \pm SD$	$x \pm SD$		
Psychoticism	1.55 ± 0.49	1.50 ± 0.46	1.02	$P>0.05$
Somatization	1.37 ± 0.42	1.28 ± 0.33	1.54	$P>0.05$
Paranoid	1.76 ± 0.61	1.83 ± 0.52	-1.25	$P>0.05$
Compulsion	1.85 ± 0.58	1.97 ± 0.59	-1.92	$P>0.05$
Phobia	1.37 ± 0.44	1.34 ± 0.34	0.8	$P>0.05$
Interpersonal relationship	1.88 ± 0.53	1.96 ± 0.54	-1.42	$P>0.05$
Hostility	1.64 ± 0.50	1.70 ± 0.58	-0.99	$P>0.05$
Depression	1.72 ± 0.57	1.80 ± 0.56	-1.35	$P>0.05$
Anxiety	1.57 ± 0.49	1.66 ± 0.53	-1.62	$P>0.05$

In the light of the data from table 1, we know that there are no significant differences among all these psychological factors of students in the early stage of aerobics training.

2.2 Research methods

Documentation method： 25 journal articles on how sports affect college students are retrieved from CNKI and digested in this paper, which provides a theoretical basis for extracting the measurable indicators of college students' psychological changes.

Questionnaire survey method: This paper designed the SCL-90 symptom checklist and used it to conduct the self-assessment investigation on students attending aerobics course.

Teaching experiment methodology： Mental health diagnosis is conducted on 100 college students in the early stage of the aerobics course and in its later stage. As for the experiment scale, the universal symptom checklist SCL-90 scale at home and abroad that is drawn up by Derogatis *et al* is employed in this paper. This table consists of 90 items and 9 factors. These 9 factors are psychoticism, somatization, paranoid, compulsion, phobia, interpersonal relationship, hostility, depression and anxiety respectively in table 1.

Mathematical statistical method： The mean and standard deviation of sample data are analyzed and the independent-samples t-test is employed. Through this method, t in two sets of data is calculated and the corresponding P that displays significance level is given. With respect to data processing, the SPSS19.0 statistical software is used.

2.3 Design of aerobics course

The objective of aerobics course is to develop the psychological quality of college students by way of aerobics. The 100 college students are 19 ± 1 years old with 35 male students and 65 female ones.

Course content consists of the following four sections:

1）Collective practice: students should practice all basic steps for 5 minutes, do body posture exercises for 5 minutes and complete movement exercises for 15 minutes with the music rhythm.

2）Group training：students should conduct teamwork exercises for 10 minutes, mutual instruction for 15 minutes

and formation composing for 10 minutes.

3）Role reversal：students should do this exercise for 15 minutes to cultivate their confidence.

4）Challenge competition: students should do this exercise for 20 minutes to cultivate their frustration capacity through positive competition.

Students attend the aerobics course twice a week with each course lasting 90 minutes. The form of practice is a combination of collective practice and grouping training. The exercise intensity is 130 ± 10 times per minute.

3. PRINCIPLE AND STEPS OF INDEPDENT-SAMPELS T-TEST

T-test is a statistical quantity used to measure the differences of mean between two different populations with a view to determining whether the tested two independent samples originate from the population with the same mean. If the statistical test were to be conducted on these two sets of samples, the following three requirements would have to be met.

1）these two sets of data under comparison are independent from each other and have no matching relationship;

2）both of these two sets of samples originate from normal population;

3）mean is the descriptive statistical quantity that is of significance to test.

When two sets of independent samples meet the above three requirements, the operation steps of t-test are conducted which are shown as follows:

STEP1. Establish null hypothesis and alternative hypothesis

The null hypothesis H_0 of two independent-samples t-test means that the means of two populations have no significant differences. The mathematical representation is shown in formula （1）.

$$H_0 : H_0 : \mu_1 - \mu_2 = 0; H_1 : \mu_1 - \mu_2 \neq 0 \quad (1)$$

In formula （1）, μ_1 and μ_2 stand for the mean of the first population and that of the second population respectively.

STEP2. Select test statistics

The mean difference of two population samples serves as the inference basis of the mean difference of two populations. In other words, the mean difference of two sets of samples is used to estimate the mean difference of two populations. But at this stage the sampling distribution of the mean of two samples should also be paid attention to. If the distributions of two populations are $N(\mu_1, \sigma_1^2)$ and $N(\mu_2, \sigma_2^2)$ respectively, the sampling distribution of two samples' mean difference is also positive. Its mean is $\mu_1 - \mu_2$ and variance is σ_{12}^2. However, under different circumstances, the calculation of σ_{12}^2 has different methods. Under the circumstance of $\sigma_1 = \sigma_2$, the variances of two populations are unknown but equal. Under the circumstance of $\sigma_1 \neq \sigma_2$, the variances of two populations are unknown and unequal. Therefore, with respect to the former circumstance, combined variance can be used as the estimation of the variances of two populations. Its mathematical definition is shown in formula （2）.

$$Sp^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \quad (2)$$

In formula （2）, S_1^2 and S_2^2 stand for the variance of the first set of samples and that of the second set respectively. n_1 and n_2 represent the number of the first set of samples and that of the second set respectively. The variance σ_{12}^2 of the sampling distribution of two samples' mean difference is shown in formula （3）.

$$\sigma_{12}^2 = \frac{Sp^2}{n_1} + \frac{Sp^2}{n_2} \quad (3)$$

In the latter case, it is of necessity to employ their variances respectively. The variance σ_{12}^2 of the sampling distribution of two samples' mean difference can be computed by formula （4）.

$$\sigma_{12}^2 = \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \quad (4)$$

Therefore, the mathematical definition of the test statistics of two populations' mean difference is shown in formula （5）:

$$\mathrm{T} = \frac{\overline{X}_1 - \overline{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\sigma_{12}^2}} \quad (5)$$

In the case of $\sigma_1 = \sigma_2$, statistical quantity T is subject to the t distribution of $(n_1 + n_2 - 2)$ free degrees. In the case of $\sigma_1 \neq \sigma_2$, it is subject to the t distribution of amended freedom of degree. The mathematical definition of amended freedom of degree is shown in formula （6）:

$$f = \frac{n_1 n_2 (n_2 S_1^2 + n_1 S_2^2)^2}{n_2^3 S_1^2 + n_1^3 S_2^2} \quad (6)$$

STEP3. Calculate the observed value of test statistics and the probability value P.

This step aims to calculate the observed values of statistical quantity F and T and the corresponding probability value P. Using the SPSS software can automatically help to obtain the statistical quantity F and probability value P based on the uni-variate variance analysis method. This software can also automatically substitute the mean, number of samples and variance of sampling distribution into formula （5）, after which the observed values of statistical quantity T and the corresponding probability value P are obtained.

STEP4. Preset the significance level α and make decisions

Firstly, use the F-test to judge whether the variances of two populations are equal and determine the calculation methods and results of sampling distribution variance and freedom degree according to the numerical relationship between two variances. If the probability P of test statistic F is smaller than the significance level α, the null hypothesis should be rejected and the conclusion that there are significant differences between the variances of two populations could be drawn. Otherwise, it is thought that there are no significant differences between the variances of two populations.

Then t-test is used to judge whether there are significant differences between the means of two populations. If the probability value P of t-test statistic is smaller than the significance level α, then the null hypothesis should be rejected and the conclusion that there are significant differences between the means of two populations could be drawn. Otherwise, it is thought that there are no significant differences between the means of two populations
Ultimately, corresponding conclusions are drawn according to different statistical objectives.

4. QUESTIONNAIRE DESIGN AND EMPIRICAL ANALYSIS ON THE EXTENT TO WHICH THE AEROBICS COURSE PROMOTES PSYCHOLOGICAL DEVELOPMENT

4.1 Questionnaire design

The symptom checklist SCL-90 designed in this paper requires that apart from filling in name, gender and age, students should complete the questionnaire that consists of 90 one-of-five multiple-choice questions. To measure students' current mental health level more accurately, students are required to answer all questions within 25 minutes. Questionnaire topic design is shown in table 2.

Tab. 2: Topic design of symptom checklist

Question number	Topic	Option	Question number	Topic	Option
1	headache	no, slight, moderate, serious, severe	46	difficulty in making decisions	no, slight, moderate, serious, severe
2	hyperaesthesis	no, slight, moderate, serious, severe	47	fear of traffic	no, slight, moderate, serious, severe
3	over-thinking	no, slight, moderate, serious, severe	48	difficulty in breathing	no, slight, moderate, serious, severe
4	vertigo	no, slight, moderate, serious, severe	49	now cold, now hot	no, slight, moderate, serious, severe
5	heterosexual boredom	no, slight, moderate, serious, severe	50	avoidance because of fear	no, slight, moderate, serious, severe
6	demanding perfection	no, slight, moderate, serious, severe	51	empty mind	no, slight, moderate, serious, severe
7	non-assertiveness	no, slight, moderate, serious, severe	52	body tingling	no, slight, moderate, serious, severe
8	complaining about others	no, slight, moderate, serious, severe	53	throat infarction	no, slight, moderate, serious, severe
9	forgetfulness	no, slight, moderate, serious, severe	54	hopelessness	no, slight, moderate, serious, severe
10	concern about deportment	no, slight, moderate, serious, severe	55	attention unfocused	no, slight, moderate, serious, severe
11	easily agitated	no, slight, moderate, serious, severe	56	weak and feeble	no, slight, moderate, serious, severe
12	chest pain	no, slight, moderate, serious, severe	57	easy to be nervous	no, slight, moderate, serious, severe
13	fear of open space	no, slight, moderate, serious, severe	58	heavy hands and feet	no, slight, moderate, serious, severe
14	activity slowing down	no, slight, moderate, serious, severe	59	thought of death	no, slight, moderate, serious, severe
15	suicide	no, slight, moderate, serious, severe	60	eating too much	no, slight, moderate, serious, severe
16	not listening to others	no, slight, moderate, serious, severe	61	annoyed with others' talk	no, slight, moderate, serious, severe
17	tremble	no, slight, moderate, serious, severe	62	no idea	no, slight, moderate, serious, severe
18	not trusting others	no, slight, moderate, serious, severe	63	impulse to hurt others	no, slight, moderate, serious, severe
19	poor appetite	no, slight, moderate, serious, severe	64	waking up too early	no, slight, moderate, serious, severe
20	easy to cry	no, slight, moderate, serious, severe	65	washing hands repeatedly	no, slight, moderate, serious, severe
21	socially shy	no, slight, moderate, serious, severe	66	sleeping not sound	no, slight, moderate, serious, severe
22	lack of security	no, slight, moderate, serious, severe	67	wanting to throw things around	no, slight, moderate, serious, severe
23	fear for no reason	no, slight, moderate, serious, severe	68	unique thoughts	no, slight, moderate, serious, severe
24	out-of-control temper	no, slight, moderate, serious, severe	69	sensitive to people	no, slight, moderate, serious, severe
25	fear to go out alone	no, slight, moderate, serious, severe	70	restless in a certain place	no, slight, moderate, serious, severe
26	blame yourself	no, slight, moderate, serious, severe	71	difficulty in doing things	no, slight, moderate, serious, severe
27	lumbago	no, slight, moderate, serious, severe	72	burst of fear	no, slight, moderate, serious, severe
28	self-perceived poor skills	no, slight, moderate, serious, severe	73	feeling uneasy eating in a certain place	no, slight, moderate, serious, severe
29	self-perceived loneliness	no, slight, moderate, serious, severe	74	arguing with others	no, slight, moderate, serious, severe
30	self-perceived depression	no, slight, moderate, serious, severe	75	nervous being alone	no, slight, moderate, serious, severe
31	excessive worry	no, slight, moderate, serious, severe	76	suffering from injustice	no, slight, moderate, serious, severe
32	no interest in things	no, slight, moderate, serious, severe	77	loneliness in the midst of bustle	no, slight, moderate, serious, severe
33	fear	no, slight, moderate, serious, severe	78	restlessness	no, slight, moderate, serious, severe
34	emotional injury	no, slight, moderate, serious, severe	79	no self-identity	no, slight, moderate, serious, severe
35	private business known to others	no, slight, moderate, serious, severe	80	distortion of things	no, slight, moderate, serious, severe
36	not to be understood	no, slight, moderate, serious, severe	81	shouting	no, slight, moderate, serious, severe
37	not to be liked	no, slight, moderate, serious, severe	82	fear of fainting	no, slight, moderate, serious, severe
38	seeking precision in a slow pace	no, slight, moderate, serious, severe	83	feeling at disadvantage	no, slight, moderate, serious, severe
39	severe heartbeat	no, slight, moderate, serious, severe	84	annoyed because of sex	no, slight, moderate, serious, severe
40	nausea	no, slight, moderate, serious, severe	85	to be punished because of faults	no, slight, moderate, serious, severe
41	inferior to others	no, slight, moderate, serious, severe	86	doing things for quickness	no, slight, moderate, serious, severe
42	muscular soreness	no, slight, moderate, serious, severe	87	self-perceived illness	no, slight, moderate, serious, severe
43	subject to criticism	no, slight, moderate, serious, severe	88	not close to others	no, slight, moderate, serious, severe
44	difficulty in falling asleep	no, slight, moderate, serious, severe	89	feeling guilty	no, slight, moderate, serious, severe
45	doing things repeatedly	no, slight, moderate, serious, severe	90	sick mind	no, slight, moderate, serious, severe

Use the questionnaire topics shown in table 2 to assess scores of nine psychological factors. Five options in the questionnaire represent five levels of each index. All indexes are low-quality ones. In other words, the smaller the score, the better the index. Among these five options, the corresponding scores of no, slight, moderate, serious, and severe are 0.1, 0.2, 0.3, 0.4 and 0.5 respectively. In terms of the corresponding indexes of psychotic mental factors, if the score of the level of each index is g_{ij}, the resulting score of a student's psychotic mental factor is represented by G_j. The calculation of the mean $\bar{x}$ and standard deviation SD of that factor is shown in formula（7）:

$$\begin{cases} G_j = \sum_{i=1}^{n} g_i \\ \overline{x} = \frac{1}{100}\sum_{j=1}^{100} G_j \\ SD = \sqrt{\frac{1}{100}\sum_{j=1}^{100}\left(G_j - \overline{x}\right)^2} \end{cases} \quad (7)$$

In formula （7）, n stands for the number of indexes of psychotic mental factors.

4.2 Result analysis of the comparison between the early scale and later scale of students attending aerobics course

Using the method shown in formula （7） and the questionnaire shown in table 2, we can obtain the SCL-90 scale data in the early stage and that in the later stage of students attending aerobics course. The comparison result of all psychological factor data of the two stages can be gained by employing the SPSS19.0 statistical software.

Tab. 3: Comparison result of students' early and later psychological factor data in aerobics course

Psychological factor	Early learners（N=100）	Later learners（N=100）	t	P
	$x \pm SD$	$x \pm SD$		
Psychoticism	1.50 ± 0.46	1.47 ± 0.39	0.50	P >0.05
Somatization	1.28 ± 0.33	1.19 ± 0.22	2.13	P <0.05
Paranoid	1.83 ± 0.52	1.68 ± 0.38	2.79	P <0.05
Compulsion	1.97 ± 0.59	1.66 ± 0.61	3.68	P <0.01
Phobia	1.34 ± 0.34	1.32 ± 0.34	0.40	P >0.05
Interpersonal relationship	1.96 ± 0.54	1.70 ± 0.49	4.25	P <0.01
Hostility	1.70 ± 0.58	1.61 ± 0.49	1.20	P >0.05
Depression	1.80 ± 0.56	1.63 ± 0.25	2.77	P <0.01
Anxiety	1.66 ± 0.53	1.52 ± 0.15	2.54	P <0.05

In the light of the data in table 3, we know that in general, the factor mean of students has decreased significantly after aerobics training. After passing the independent-samples t-test, the significance level P of three factors including somatization, paranoid and anxiety is less than 0.05. After aerobics training, the above three psychological factors of students have significant differences. From the numerical point of view, significant improvements have been achieved. The significance level P of three factors including compulsion, interpersonal relationship and depression is less than 0.01. After aerobics training, the above three psychological factors of students have very significant differences. From the numerical point of view, very significant improvements have been achieved. By contrast, the significance level P of three factors including psychoticism, phobia and hostility is more than 0.05. There are no significant differences between early learners and later learners. From the numerical point of view, some improvements have been achieved.

From the survey, we can obtain the number of students with healthy psychological factors in the early and later stage of aerobics course, as shown in table 4.

Tab. 4: Comparison of the number of students with healthy psychological factors in the early and later stage of aerobics course

Symbol	Psychological factor	The number of healthy students in the initial stage（Pre）	The number of healthy students in the later stage（Fin）	Difference（Err）
A	**Psychoticism**	78	100	22
B	**Somatization**	75	100	25
C	**Paranoid**	30	80	50
D	**Compulsion**	12	75	63
E	**Phobia**	85	100	15
F	**Interpersonal relationship**	19	90	71
G	**Hostility**	24	50	26
H	**Depression**	16	70	54
I	**Anxiety**	26	65	39

By virtue of the data in table 4, we can get the column chart of the comparison of the number of students with healthy psychological factors in the early stage and later stage of aerobics course respectively.

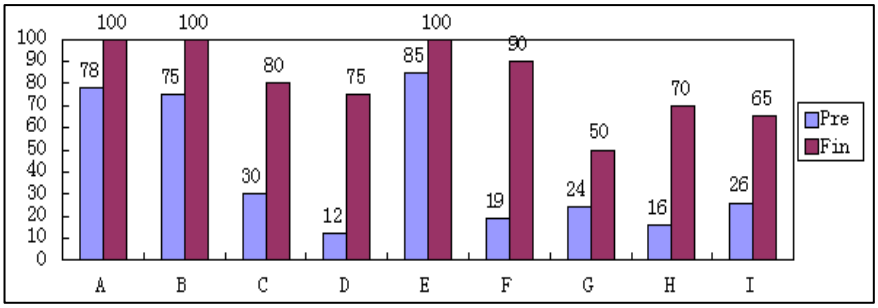

Fig.1: The column chart of the comparison of the number of students with healthy psychological factors in the early stage and later stage of aerobics course respectively

The data in table 4 and figure 1 originate from the comparison between students' early and later psychological factor levels and the data mean of national norm shown in table 1. The psychological factor level is seen as a healthy one if it is less than the national nom and the result is shown in table 4 and figure 1. From the correlation data, we know that more than 50 students reach the healthy level of three psychological factors including somatization, phobia and psychoticism in the early and later stage of aerobics course. The number of students that reach the healthy level of other factors is less than 50 in the early stage whereas the number surpasses 50 in the later stage. The number of students that reach the healthy level of three psychological factors including somatization, phobia and psychoticism is 100. From the perspective of difference levels, the trend is displayed in figure 2.

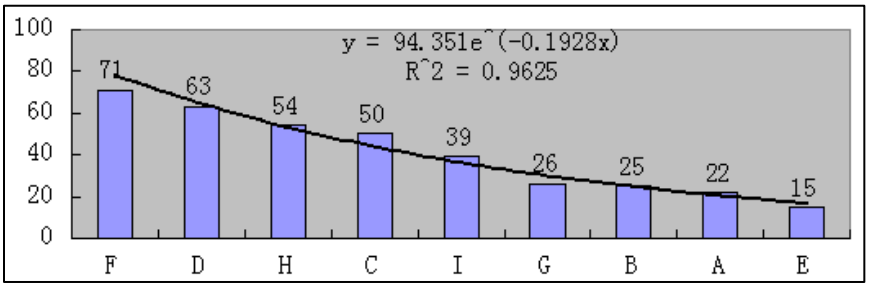

Fig. 2: Trend of difference changes between the number of students who reach the healthy level of aerobics course in the early stage and the number in the later stage

Figure 2 demonstrates that the change of psychological factors including F-interpersonal relationship, D-compulsion, H-depression, C-paranoid, I-anxiety, G-hostility, B-somatization, A-psychoticism and E-phobia shows an index-declining trend. The goodness of fit reaches 0.9625.

5. THEORETICAL ANALYSIS ON THE EXTENT TO WHICH AEROBICS PROMOTES THE PSYCHOLOGICAL DEVELOPMENT OF STUDENTS

From the design of aerobics course, we can see that aerobics has significant effects on promoting the psychological development of students and can enhance students' physical quality. At the same time, it has specific requirements on the action carriage and body shape.

As a sport that displays the beauty of human body, aerobics requires that students create beauty through their motion. It entirely relies on students' qualities to show the strength and beauty of human body. With the dynamic music, it stimulates students' emotions. Therefore, students can raise perception of beauty after aerobics training. But this also requires that students should be full of emotion in the language transfer of lower limb through music and mobilize positive and healthy high-grade emotion, which is the driving force of aerobics to promote the psychological development of students. The effects of aerobics on promoting the psychological development of students are elaborated from five aspects in the following space.

1）Aerobics can cultivate the optimistic and cheerful mood and mind of college students. On campuses, aerobics course serves to improve the negative emotions of college students, release their pressure and keep the pleasure of mood.

2）Aerobics can establish the self-awareness of college students well. The objectives of aerobics in colleges and universities attach importance to both physical exercise and strength training. It plays a positive role in improving the body shape and temperament of students.

3）Aerobics has promoting effects in the formation process of college students' psychological quality and willpower. Firstly, as a physical exercise item, aerobics entails practice towards established exercise goals. And in the learning process, students also need to make efforts to overcome physical and psychological inertia. This is the carrier of improving the psychological quality and willpower.

4）Aerobics is of great help in the formation of college students' harmonious interpersonal relationships. As the aerobics course consists of group training and role conversion training and contests are comprised of aerobics for three people, six people and a group that entails the cooperation of others, the content indispensable to the formation of interpersonal relationships is involved in the training process of aerobics.

5）Aerobics plays a certain role in healing the adverse mental illness of college students. The training environment of aerobics is characterized with musical rhythm, cheerful beat and moderate strength. In addition, aerobics is an aerobic group exercise. All these factors help those with psychological disorders let off negative emotions and significantly improve such psychological factors as somatization, psychoticism and phobia.

To sum up, aerobics course plays a significant role in promoting the psychological development of college students.

CONCLUSION AND DISCUSSION

This paper firstly designs the objectives, contents, training frequency and training forms of aerobics course, which provides a basis for the research on the extent to which aerobics promotes the mental health level of college students.

Then, it elaborates on the principle and operation steps of independent-samples t-test. As this research focuses on the differences of students' psychological factors between the early stage and the later stage of aerobics training, t and P resulting from t-test are important statistical parameters that reflect such difference. This lays a theoretical foundation for the research on the extent to which aerobics promotes the psychological development of students.

Ultimately, a questionnaire for the SCL-90 scale is designed. The questionnaire data compare and analyze students' psychological factors between the early stage and later stage and obtains the improvement effects of all psychological factors after aerobics training. That is, the changes of all psychological factors including F-interpersonal relationship, D-compulsion, H-depression, C-paranoid、I-anxiety, G-hostility, B-somatization, A-psychoticism and E-phobia show an index-declining trend.

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