Variance analysis-based students physical exercises gender difference and their mental health test (MHT) research

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ABSTRACT

With slogan of sport power being put forward, and national fitness development, physical exercises have already gone deeper into Chinese people's life, and been closely related to psychological health. The paper utilizes variance analysis, comparative analysis methods, analyzes Chinese physical exercises status and its impacts on psychological health. Firstly, make specific analysis of physical exercises gender difference, from which it contains men and women physical exercises engagement frequency, sports events participation different options proportions and psychological health status, and then analyze physical exercises gender differences. Secondly, establish variance analysis-based physical exercises impact model on MHT, compare regular participating in and don't regular participate in physical exercises profile of mood states (POMS) and mental health test (MHT) each kind of indicators. Finally it gets conclusion that physical exercises impacts on psychological health have significant gender difference, profile of mood states (POMS)and mental health test (MHT) each kind of indicators suffered impacts from physical exercises are also very significant, and especially for schoolgirls.

KEYWORDS

Physical exercises; Gender difference; Mental health; Variance analysis.

INTRODUCTION

With economic rapidly development, people are no longer satisfied with simple pursuit of material life, but have higher requirements on spiritual life, but due to suffer work and life pressure impacts, many people suffer mental disorder to a certain degree. As one of key factors that impact on mental health, physical exercises have become main paths to relax and relieve emotions. No matter in medical circle, or in sports circle, physical exercises play crucial roles.

Shi Wen-Yan in the article "University participating in physical exercises and mental health relational research", she pointed out that physical exercises had closely relations with mental health. The thesis took university students as main research objects, started from university students physical exercise participation frequency, participation events, participation time and other perspectives, analyzed their physical exercises status, and combined with contemporary students psychological health, made quantitative analysis of physical exercises and mental health relations by mathematical methods, and then got that physical exercises were important paths to promote contemporary university students mental health, improve their physical quality and relieve pressure.

Zhou Jian-Xin in the article "Research on sports option course teaching impacts on university students mental health", pointed out that sports option course was the key to effect on university students to take physical exercises and propel to physical and mental health in current stage. The thesis took sports option course as main perspective, specific researched contemporary universities sports option course items, option course class hours, students satisfaction and so on, and carried on further analysis on university students mental health level, so that highlighted that physical exercise took very important position in university students education, sports teaching not only impacted on university students physical health development, but also the most important was that it affected university students mental health.

Zhao Yun-Shu in the article "Contemporary middle school students sports psychological quality development features", pointed out contemporary middle school students suffered multiple factors influences, their sports psychological quality were lower. The thesis referenced lots of previous research results, and on this basis, it made practical investigation, collected first hand data information by the form of questionnaire, sorted out and analyzed data, and then got the conclusion that contemporary middle school students learning pressure was bigger, most of school physical education course was occupied by cultural course, so that led to contemporary middle school students sports psychological quality development was relative slow, their psychological quality level was lower, with respect to this, it should strengthen sports teaching on middle school students and avoid occurrence of physical education course being occupied.

Zhang Xiao-Ning in the article "Briefly discuss on physical exercises impacts on technical school students' mental health" briefly discussed physical exercises main functions that were effects on mental health. The thesis took middle school students as research objects, by researching on middle school students physical course status, and further analyzed their mental health, and got conclusion that physical exercises was important indicators that affected middle school students mental health, it should enhance sports teaching position in middle school students teaching so as to propel to middle school students healthy growth and comprehensive promote their physical health.

The paper combines with previous research results, utilizes mathematics variance analysis, studies on physical exercises gender difference and its impacts on mental health, and puts forward that physical exercises have obvious gender difference, people that take physical exercises regularly, their psychological quality is higher, and their mental health each indicators have great differences with the people don't participate in physical exercises.

PHYSICAL EXERCISES GENDER FEATURES

Men and women exercises frequency status

Physical exercises not only is beneficial to physical and mental health, helpful for strengthening one's physique, but also can relax mood, and its impacts on a person emotion are also very important.

Due to physical quality, living habits differences, schoolboys and schoolgirls attitudes toward physical health are significant different, physical exercise participation frequency are not completely the same. Below TABLE 1 are the men and women physical exercise status comparison, data is from national students' physique and health investigation result announcement and general administration of sport of China relative investigation report.

TABLE 1 : Men and women exercises frequency status

Frequency	Exercise regularly	Don't exercise regularly	Don't exercise
Number of schoolboys	62.20%	43.61%	35.71%
Number of school girls	37.80%	56.39%	64.29%

Draw above TABLE 1 into statistical chart, and analyze conclusion:
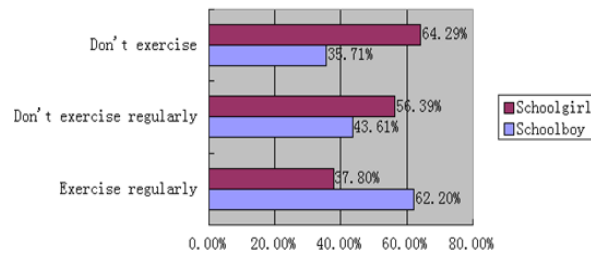

Figure 1 : Men and women exercise frequency condition

Above statistical Figure 1 shows that for physical exercises, it has obvious difference between men and women. Schoolboys mostly take physical exercises while schoolgirls rarely participate in physical exercises. Schoolboys that exercise regularly occupy 62.2%, and proportion of schoolgirls are only around half the schoolboys. It illustrates presently Chinese physical exercises gender distribution is seriously out of balance, and especially for schoolgirls, so it should encourage schoolgirls to positive participate in physical exercises.

Different sports events men and women participation status

For schoolboys and schoolgirls, sports event participation habits are different. Usually, basketball, badminton, tennis, running, swimming are favored by all and are sports activities that participate regularly, these activities have important impacts on our physical and mental health. Below TABLE 2 are different genders participation proportion in these kinds of sports activities, data is from Chinese statistical yearbook, internet relative data.

TABLE 2 : Different genders sports habits

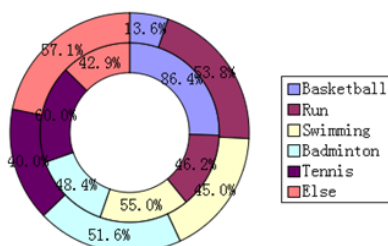| Item	Basketball	Running	Swimming	Badminton	Tennis	Others
Schoolboys participation proportion	86.4%	46.2%	55%	48.4%	60%	42.9%
Schoolgirls participation proportion	13.6%	53.8%	45%	51.6%	40%	57.1%

Figure 2 : Different gender sports habits

From above statistical Figure 2, it is clear that for basketball, tennis, swimming and other events schoolboys' participation proportion is far higher than schoolgirls, while for badminton, running and other events, schoolgirls' participation proportion is higher. It shows schoolboys tends to more fierce sports when select sports activities, while schoolgirls are more inclined to relieved sports.

Different genders mental status

When schoolboys and schoolgirls physical exercising selected amount of exercise and sports frequency are different, it will lead to their mental health status to be different. The bigger amount of exercise is, the more obvious impacts on mental health would be. In general, schoolboys mental health status is better, which is also the benefit from they regularly participating in physical exercises, their physical and mental physique is better than schoolgirls.
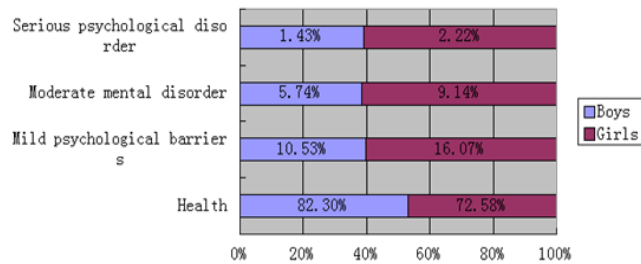

Figure 3 : The mental health status of the different gender

Above Figure 3 is different genders mental health status, data is from general administration of sport of China, national students' physique and health investigation result announcement. By above statistical chart, it can get conclusion that schoolboys rarely occur to mental disorder, 82.3% schoolboys' mentality is very healthy, and schoolgirls are only 72.58%. Besides, schoolgirls serious mental disorder occurrence odd is 2.22%, and schoolboys only have 1.43%.

Different genders physical exercise habits and mental health comparative analysis

Physical exercise habits and mental health have closely relations, and to different genders, their mental health has obvious difference. Below are correlation data table that about men and women physical exercise frequency and mental health status by respectively analyzing the two with correlation analysis method, and further carry out comparative analysis.

Correlation analysis is utilizing software to handle with data, comparing correlation by comparing correlation coefficient size. Pearson correlation coefficient computational formula is as following:

$$\rho(X,Y) = \frac{\text{cov}(X,Y)}{\sigma_x \sigma_y} = \frac{E\big((X-\mu_x)(Y-\mu_y)\big)}{\sigma_x \sigma_y}$$

Among them, covariance is used as numerator, is product of two variables standard deviation, and requires that two variables standard deviation cannot be 0.

And $\mu_x = E(X), \sigma_X^2 = E(X-\mu_x)^2 = E(X^2) - E^2(X)$

So, Pearson correlation coefficient can also be written as:

$$\rho(X,Y) = \frac{E(XY) - E(X)E(Y)}{\sqrt{E(X^2) - E^2(X)}\sqrt{E(Y^2) - E^2(Y)}}$$

When two variables Pearson correlation coefficient gets closer to 1or -1, it shows the two correlation is big or has close relations. Get closer to 1 shows the two are in positive correlation, on the

contrary get closer to -1 shows the two are in negative correlation. Below is correlation analysis statistical TABLE 3 and TABLE 4.

TABLE 3 : Schoolgirls data table

Schoolgirls	Health	Mild psychological barrier	Moderate psychological disorder	Serious psychological disorder
Health status	72.58%	16.07%	9.14%	2.22%
Exercise frequency	19.85%	37.80%	56.39%	64.29%

TABLE 4: Schoolboys data table

Schoolboys	Health	Mild psychological barrier	Moderate psychological disorder	Serious psychological disorder
Health status	82.30%	10.53%	5.74%	1.43%
Exercise frequency	62.20%	43.61%	35.71%	20.15%

By SPSS software to respectively analyze above data table, it gets TABLE 5:

TABLE 5 : Correlation

		Exercise frequency men	Exercise frequency women
Mental health (Men)	Pearson correlation	.879	-.879
	Significance (bilateral)	.121	.121
Mental health (Women)	Pearson correlation	.914	-.912
	Significance (bilateral)	.086	.088

**. Significant correlated in.01 level (bilateral); *. Significant correlated in 0.05 level (bilateral)

By above correlation TABLE 5, it is clear that men and women mental health statuses are significant correlated to their physical exercises frequency. For schoolboys, their mental health status and physical exercises Pearson correlation coefficient is 0.879, and schoolgirls' are 0.914. It is clear that schoolgirls mental health status affected by physical exercises are more serious, therefore it should encourage schoolgirls to positive participate in physical exercises, and propel to their mental health development.

VARIANCE ANALYSIS METHOD-BASED PHYSICAL EXERCISES IMPACTS ON MENTAL HEALTH TEST (MHT)

MHT is abbreviation of mental health test; its main contents include learing, anxiety with people, have inclinations of loneliness, self-accusation and allergy, and even have inclinations of impulsion and terror. In research on physical exercises to mental health impact, people go through physical exercises, their mental status have obvious differences with the people don't go through physical exercises. With respect to this, make variance analysis of them, so that compare MHT indicators quantity of the ones that go through physical exercises and don't go through physical exercises, and gets conclusion. Below TABLE 6 and TABLE 7 are Chinese students' mood state and mental health indicators investigation table, data is from national students' physique and health investigation result announcement.

Two factors variance analysis guiding thought
Variance analysis is considering factors impacts on indicators. Research objects experiment result is indicator, control variable, condition that is factors. When research objects influence factors are two, it should consider two factors variance analysis. Set it has two influence factors A, B, make respective classification of A, B into some levels, and make several times test on every level, make

variance analysis of data, and then research on A, B two influence factors respective significances on research objects impacts. Sometimes, it should make further test whether A, B have significant interactive impacts on research objects.

Its mathematical model is :set A to take r pieces of level $A_1, A_2, \cdots, A_r$, B takes s pieces of level $B_1, B_2, \cdots, B_s$, under level combination (A_i, B_j), totality x_{ij} conforms to normal distribution $N(\mu_{ij}, \delta^2), i = 1, \cdots, r, j = 1, \cdots, s$. And under A_i, B_j, it makes t pieces of experiments, record result as x_{ijk}, x_{ijk} conforms to $N(\mu_{ij}, \delta^2), i = 1, \cdots, r, j = 1, \cdots, s, k = 1, \cdots, t$, and mutual independent. And then it can get following TABLE 8:

TABLE 6 : Mood state analysis table

Each component table	Don't participate in physical exercises M ± SD	Exercise regularly M ± SD
TMD	282.45 ± 43.57	243.18 ± 48.22
Nervous	51.35 ± 13.21	47.32 ± 20.09
Anger	53.28 ± 12.95	49.01 ± 11.22
Fatigue	52.85 ± 12.34	48.34 ± 9.48
Depression	55.22 ± 12.98	48.34 ± 9.87
Vigor	42.76 ± 10.38	50.87 ± 11.23
Panic	41.73 ± 13.37	34.73 ± 11.21
Self-esteem	45.95 ± 12.51	54.31 ± 13.36

TABLE 7 : Mental health test table

Each component table	Don't participate in physical exercises M ± SD	Exercise regularly M ± SD
Learning anxiety	5.41 ± 2.11	4.36 ± 2.28
Be anxiety with people	5.38 ± 1.91	4.82 ± 1.76
Loneliness inclination	3.79 ± 1.41	3.21 ± 1.22
Self-accusation inclination	5.32 ± 1.56	4.26 ± 1.57
Allergy inclination	5.35 ± 1.21	4.33 ± 1.45
Body symptom	5.22 ± 1.63	5.64 ± 1.86
Terror symptom	5.36 ± 1.73	4.89 ± 1.62
Impulsion inclination	5.34 ± 1.33	4.95 ± 1.76

TABLE 8 : Variance analysis data table

	B_1	B_2	…	B_s
A_1	$x_{111} \cdots x_{11t}$	$x_{121} \cdots x_{12t}$	…	$x_{1s1} \cdots x_{1st}$
A_2	$x_{211} \cdots x_{21t}$	$x_{221} \cdots x_{22t}$	…	$x_{2s1} \cdots x_{2st}$
⋮	⋮	⋮	⋮	⋮
A_r	$x_{r11} \cdots x_{r1t}$	$x_{r21} \cdots x_{r2t}$	…	$x_{rs1} \cdots x_{rst}$

Decompose x_{ijk} into:

$$x_{ijk} = \mu_{ij} + \varepsilon_{ij}, i = 1, \cdots, r, j = 1, \cdots, s, k = 1, \cdots, t$$

Among them, $\varepsilon_{ijk} \sim N(\mu_{ij}, \delta^2)$, and mutual independent, record:

$$\mu = \frac{1}{rs}\sum_{i=1}^{r}\sum_{j=1}^{s}\mu_{ij}, \mu_{i\bullet} = \frac{1}{s}\sum_{j=1}^{s}\mu_{ij}, a_i = \mu_{i\bullet} - \mu$$

$$\mu_{i\bullet} = \frac{1}{r}\sum_{i=1}^{r}\mu_{ij}, \beta_i = \mu_{\bullet j} - \mu, \gamma_{ij} = \mu_{ij} - \mu - \alpha_i - \beta_i$$

Among them, μ is grand average, α_i is level A_i effect on indicator, β_i is level B_i effect on indicator, γ_{ij} is level A_i and level B_i interaction effect on indicator. Model table is:

$$\begin{cases} x_{ijk} = \mu + \alpha_i + \beta_j + \gamma_{ij} + \varepsilon i_j \\ \sum_{i=1}^{r}\alpha_i = 0, \sum_{j=1}^{s}\beta_j = 0, \sum_{i=1}^{r}\gamma_{ij} = \sum_{j=1}^{s}\gamma_{ij} = 0, \\ \varepsilon_{ijk} \sim N(0, \delta^2), i = 1, \cdots, r, j = 1, \cdots, s, k = 1, \cdots, t \end{cases}$$

Original hypothesis is :

$$H_{01} : \alpha_i = 0(i = 1, \cdots, r)$$
$$H_{02} : \beta_j = 0(j = 1, \cdots, s)$$
$$H_{03} : \gamma_{ij} = 0(i = 1, \cdots, r, j = 1, \cdots, s)$$

If two factors have no interaction effects, let $t = 1$, process can simplify, assume $\gamma_{ij} = 0$, then:

$$\mu_{ij} = \mu + \alpha_i + \beta_i, i = 1, \cdots, r, j = 1, \cdots, s$$

Now, model can be written as :

$$\begin{cases} x_{ij} = \mu + \alpha_i + \beta_j + \varepsilon i_j \\ \sum_{i=1}^{r}\alpha_i = 0, \sum_{j=1}^{s}\beta_j = 0 \\ \varepsilon_{ijk} \sim N(0, \delta^2), i = 1, \cdots, r, j = 1, \cdots, s \end{cases}$$

Below is test statistics:

$$\bar{x} = \frac{1}{rs}\sum_{i=1}^{r}\sum_{j=1}^{s}x_{ij}, x_{i\bullet} = \frac{1}{s}\sum_{j=1}^{s}x_{ij}, x_{\bullet j} = \frac{1}{r}\sum_{i=1}^{r}x_{ij}$$

$$S_T = \sum_{i=1}^{r}\sum_{j=1}^{s}(x_{ij} - \bar{x})^2$$

Among them, S_T is whole test data headquarter variation, and becomes total squares sum, decompose it:

$$S_T = \sum_{i=1}^{r}\sum_{j=1}^{s}(x_{ij} - \bar{x})^2$$

$$= \sum_{i=1}^{r} \sum_{j=1}^{s} (x_{ij} - \bar{x}_{i\bullet} - \bar{x}_{\bullet j} + \bar{x})^2 + s \sum_{i=1}^{r} (x_{ii\bullet} - \bar{x})^2 + r \sum_{j=1}^{s} (x_{\bullet j} - \bar{x})^2$$

$$= S_E + S_A + S_B$$

It can verify: in above squares sum decomposition, cross terms are 0. Among them:

$$S_E = \sum_{i=1}^{r} \sum_{j=1}^{s} (x_{ij} - \bar{x}_{i\bullet} - \bar{x}_{\bullet j} + \bar{x})^2$$

$$S_A = s \sum_{i=1}^{r} (x_{ii\bullet} - \bar{x})^2$$

$$S_B = r \sum_{j=1}^{s} (x_{\bullet j} - \bar{x})^2$$

When H_{01} is true:

$$F_A = \frac{\dfrac{S_A}{r-1}}{\dfrac{S_E}{(r-1)(s-1)}} \sim F(r-1, (r-1)(s-1))$$

When H_{02} is true:

$$F_B = \frac{\dfrac{S_B}{r-1}}{\dfrac{S_E}{(r-1)(s-1)}} \sim F(s-1, (r-1)(s-1))$$

Test rules are:

When $F_A < F_{1-a}(r-1, (r-1)(s-1))$, accept H_{01}, otherwise refuse H_{01};

When $F_B < F_{1-a}(s-1, (r-1)(s-1))$, accept H_{02}, otherwise refuse H_{02}.

Data analysis

Use MATLAB software to analyze TABLE 6, 7, and then get following variance analysis data TABLE 9 and TABLE 10:

TABLE 9 : Mood state analysis table

Each component table	Don't participate in physical exercises M $\pm$ SD	Exercise regularly M $\pm$ SD
TMD	281.78 $\pm$ 45.56	244.18 $\pm$ 48.76
Nervous	51.28 $\pm$ 13.30	47.78 $\pm$ 20.13
Anger	53.01 $\pm$ 12.73	49.66 $\pm$ 11.03
Fatigue	52.98 $\pm$ 12.74	48.10 $\pm$ 9.52
Depression	55.21 $\pm$ 12.78	48.44 $\pm$ 9.94
Vigor	42.77 $\pm$ 10.28	50.91 $\pm$ 11.18
Panic	41.83 $\pm$ 13.50	34.83 $\pm$ 11.08
Self-esteem	45.85 $\pm$ 12.52	54.32 $\pm$ 13.35

TABLE 10 : Mental health table

Each component table	Don't participate in physical exercises M ± SD	Exercise regularly M ± SD
Learning anxiety	5.40 ± 2.01	4.366 ± 2.29
Be anxiety with people	5.38 ± 1.91	4.86 ± 1.79
Loneliness inclination	3.79 ± 1.41	3.31 ± 1.29
Self-accusation inclination	5.34 ± 1.57	4.36 ± 1.69
Allergy inclination	5.33 ± 1.31	4.32 ± 1.49
Body symptom	5.22 ± 1.63	5.73 ± 1.76
Terror symptom	5.37 ± 1.74	4.96 ± 1.63
Impulsion inclination	5.35 ± 1.23	4.95 ± 1.85

By above variance data table analysis, it is clear: No matter profile of mood states POMS or mental health test indicator MHT, all suffer physical exercises impacts. The ones that exercise regularly, their mood states each item dimension has significant difference with the ones don't exercise, its level is obvious lower than the ones don't exercise; affected by mood states, mental health each item indicator also presents significant differences, after proceeding with physical exercises, students each kind of anxiety, mental disorder inclination are obviously diminishing. It also proves that physical exercises have very important impacts on mental health.

CONCLUSION

Firstly, the paper starts from different genders physical exercise statuses, makes specific analysis of physical exercises gender difference, from which it contains men and women engaged physical exercises frequency, sports events participation different options proportions and psychological health status, and then make further analysis of different genders physical exercises habits and mental health, studies on the two correlations, and gets conclusion that both men and women mental health statuses are correlated to their physical exercises frequency, but schoolgirls mental health status affected by physical exercises are even serious.

Secondly, on this basis, utilize variance analysis, make analysis of current phase Chinese students' profile of mood states (POMS) and mental health test (MHT) each kind of indicators, by comparing two groups of data that regular participate in physical exercises and exercise physical exercises regularly, it gets: affected by physical exercises, students' profile of mood states (POMS)and mental health test (MHT)each kind of indicators have significant differences.

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