

## A Review of Research Methodology on the Effects of Physical Exercise and Mental Health of College Students

Min Li

Chengdu College of Arts and Sciences, Chengdu City, Sichuan Province 610400

**[Abstract]** College students' mental health and physical exercise, as well as the effect relationship between them, are not only a hot topic in society, but also a key topic in the research of exercise psychology and health psychology. Because the relevant research has been extremely rich, but there is still a lack of methodological analysis of the corresponding achievements of the academic community. Therefore, the methodology of variable analysis, research design and statistical processing is creatively put forward to comment on the existing research in academic circles. The purpose of this study is to find out the problems existing in the current research, and to point out the possible impact of the common third variables, such as adjusting variables and mediating variables, on the exploration of the effect mechanism of College Students' physical exercise and mental health.

**[Key words]** Physical Exercise; Mental Health; Research Design; Analysis of Variance

As an important branch of psychology, sports psychology has received worldwide attention since its birth. Exercise psychology and health psychology, which belong to sports psychology, have achieved considerable development in the 21st century. It is also very common to explore the relationship between physical exercise and mental health. By the beginning of the 21st century, there have been no less than six studies on the relationship between physical exercise and mental health. Among all kinds of people who often take part in physical exercise, because of their own particularity, the study of the impact of physical exercise on the physical and mental health of college students has become the main research field of sports psychology.

Generally speaking, college students' active participation in physical exercise will lead to a healthier psychological state. Domestic scholars have studied the relationship between the two in detail, but they lack the corresponding results analysis of the existing research in the academic field from the perspective of methodology. When applying methodological knowledge to review and summarize these studies, two methods are often used: one is the qualitative evaluation method with the significance of paper review, which mainly classifies, summarizes and summarizes the previous studies. However, this abstract description method can not draw concrete conclusions; one is quantitative evaluation method with statistical significance, also known as meta-analysis method, which is a special form of literature summary, aiming at summarizing theoretical and empirical conclusions from various literature, rather than providing documentary evidence for a particular study. [2].

Among the major literature databases in China, two papers use meta-analysis method to summarize the research on College Students' physical exercise and mental health, and get almost the same results. Huang Zhijian (2007) carried out a quantitative analysis of 14 articles (n=12219) concerning the relationship between physical exercise and mental health of college students in China. The results show that college students often take part in physical exercises, and their psychological status is better than that of students who do not take part in physical exercises. Peng Yanming (2008), a professor of Hubei Normal University, conducted a quantitative analysis of 15 articles (n=13155) concerning the relationship between physical exercise and mental health of college students in China. The results show that active physical exercise is beneficial to college students' mental health. Comprehensive studies show that college students' participation in physical exercise is helpful to cultivate healthy psychological state.

Quantitative data obtained by quantitative analysis are extremely accurate. However, due to the deviation and limitation of research hypothesis and research perspective in quantitative analysis, it is sometimes impossible to objectively and completely show the overall characteristics of the object of study. For example, some of the research results themselves have serious methodological defects. Although they have the necessary conditions for quantitative analysis, the results of the research are not necessarily reliable. In this case, the result of quantitative analysis is not an accurate presentation of the real situation. This situation can be found to be very common in the analysis of scientific research results on College Students' participation in physical exercise and mental health in China. Therefore, the research framework of methodology is applied to make a scientific analysis of the factors affecting college students' mental health, in order to provide valuable suggestions and references for future research.

The research perspective of methodology includes three main problems. The first is to determine the independent and dependent variables; the second is to ensure that the research is standardized, scientific and has validity and reliability of the research design; the third is to use statistical analysis methods to process the research results. In fact, these three issues are not only necessary links in scientific research, but also closely related. Therefore, from these three aspects, this paper reviews the effects of physical exercise and mental health of College students.

### 1. Variable Analysis

Variables can refer to events, objects or people, with two or more characteristics that can be refined, or to any object that can change the measurement indicators such as quantity and quality. There are differences between research hypothesis and research angle, and the choice and determination of research variables are also different. Scientific research in the field of sports generally includes many variables, such as those that play the role of regulation and control, those that play the role of mediator and stimulus, and those that are very common independent variables, dependent variables and counter-strain variables [7]. In fact, these variables overlap with each other and do not appear

to be independent of each other. In the experimental design of College Students' physical exercise and mental health research, it is the most important to select independent variables and determine dependent variables. Exploring the relationship between independent variables and dependent variables is also the core of the experimental research. In order to ensure the internal validity of the experimental research and the rigor of the research design, it is necessary to control the irrelevant variables. In addition, for more complex research, we need to select the third variables such as regulatory variables and intermediary variables.

Independent variables play an independent role in research, or cause variables leading to certain results, are independent variables. The independent variable in the experiment is the controlled variable, which mainly obtains the response results of the subjects under the influence of different independent variables. Once the self-variable is determined, it will play a decisive role in the whole research process. Problems in the choice of independent variables will also affect researchers' research ideas. Therefore, in the preparation of experimental research, researchers must carefully consider the types and quantities of independent variables, and take this as a starting point to clarify the significance of independent variables, which is helpful to the processing and analysis of the experimental data in a statistical sense.

The variables that influence the response in the study are dependent variables. The dependent variable in the experiment is the observed variable, which is mainly used to explore the specific reaction caused by the independent variable. Similar to independent variables, in the actual research process, researchers also need to determine the dependent variables and their number. For example, in the study, self-esteem as a dependent variable of individual mental health characteristics, we need to use the corresponding measurement tools to measure the indicators in various dimensions. In the link of testing the experimental indicators, the dependent variable can be subdivided into several experimental dependent variables. Therefore, when carrying out specific experimental research, we must pay attention to the existence of multiple experimental dependent variables.

Generally speaking, operational concepts and abstract concepts are two means of defining variables. Among them, the concept of operation refers to defining and explaining the research variables after quantitative scaling with specific and sensible indicators, phenomena or events, namely, the practical and controllable specific operating norms followed by experimental variables, as well as the clear and visible identification of characteristics. Abstract concepts refer to the abstract generalization of the essential law of research variables from the level of thinking. For example, the definition of keywords in experimental research, which is purely abstract theoretical concepts, are the specific meaning of abstract concepts [6]. For example, when evaluating athletes' pre-competition emotions, experimental research can use emotional measurement scale as the main tool to evaluate athletes' pre-competition emotions. In the process of making assumptions about athletes' competition achievements, self-orientation and task orientation of athletes can be designed into questionnaires as the main evaluation tool. Considering that the academic community has given an authoritative theoretical definition of mental health, it will not be repeated here, but will focus on the corresponding concepts of operation.

The self-rating scale of clinical symptoms is the main evaluation tool for mental health research. Some scholars analyzed the application of clinical symptom Checklist-90 (CSL-90) in assessing mental health problems at home and abroad, and found that most of the SCL-90 was used to measure the psychological status of patients abroad. Especially when patients encounter major accidents, they may show stress reaction events. This indicator is used to evaluate the mental health of patients, which is just emerging in recent years. Unlike the application abroad, SCL-90 is mainly used to measure the mental health of ordinary people in China. In addition, this normal measurement mode of ordinary people was established in the mid and late 1980s [9], which has a history of more than 30 years. Under the background of modern society, this normal measurement mode of ordinary people has obviously changed. Scholar Gao Xu (2008) believes that the main purpose of SCL-90 measurement is to measure the mental health of the subjects, not their health. The root of this phenomenon is that subject to the traditional perspective of mental health assessment, the physical condition of the subjects has become a key factor. In addition, due to the lack of mental health assessment tools, clinical symptom checklist-90, mood state scale and body self-esteem scale are easy to operate and simple, which can be used as tools to evaluate mental health. However, these measurement tools are unidirectional and are not suitable for comprehensive assessment of mental health.

## **2. Research and Design**

Control of research is the function and purpose of research and design. Quasi-experiment and real experiment design are two methods to study the effects of physical exercise and mental health of College students. Among them, quasi-experimental design is an experimental design between non-experimental design and real experimental design. Its main feature is that it can not randomly select and assign subjects, which is obviously different from real experimental design. Real experimental design can also be called experimental research design. In the research and design process, it is necessary to strictly control various conditions and select and assign the subjects of control group and experimental group in a random way. Usually, the experimental study will adopt the natural grouping method and divide the subjects into control group and experimental group. Because of the form of random grouping, it is neither necessary nor realistic. Therefore, a more realistic quasi-experimental design is adopted based on the consideration of time span. When using quasi-experimental design, the differences between subjects before intervention must be effectively controlled. The natural grouping method is adopted in the distribution of the subjects in the experiment, which leads to the difference between the subjects before the experiment intervention. It is necessary to control these differences effectively. In addition, it should be noted that the non-experimental design can only obtain the correlation between College Students'

participation in physical exercise and their overall mental health, and can not get the correlation of research needs. Therefore, the non-experimental design which has no application value can be ignored.

Many studies have not explained the design of experimental factors. For example, in the experiment, factors design, indices and hierarchical classification of individual factors, multi-factor design and single-factor design, etc., which must account for clear information in the study, have not been clearly explained. Some studies show that there are many independent variables in the experiment. But in the analysis of the experimental results, the one-way factor design method is used. In addition, the exploration of common third variables such as regulatory variables and intermediary variables has become an important analysis direction of sports science research [11]. The mechanism of psychological effect of physical exercise and its relationship with mental health may be very complex, not simple causal relationship. Therefore, it is necessary to deeply explore the regulatory effect and mediating effect of the third variable. However, due to the lack of support from statistical methods and weak basic theories in related fields, it is impossible to deduce the regulatory variables and intermediary variables. Therefore, there are few exploratory studies on such effects.

### **3. Statistical Processing**

Generally speaking, the most closely related to research and design is the statistical treatment of research results. Research design should be based on existing statistical methods, clear research design, and specific statistical processing methods have been made rigid provisions. Therefore, the research design determines the choice of statistical processing methods. However, by analyzing the research on the participation of college students in physical exercise and their overall mental health, we can find that there are two obvious misuses of statistical methods.

#### **(1) Statistical test of pre-test and post-test design for a single group**

As mentioned above, physical education teaching experiment includes physical exercise and mental health research experiment for college students, which is a quasi-experimental design with natural grouping. In the specific experimental process, before the intervention factors are compared, the psychological indicators of the subjects in the control group and the experimental group are usually not significantly different; then, the control group and the experimental group after the intervention are compared separately; finally, it is determined that physical exercise can promote mental health. This simple and sparse data processing method is very common in sports science research and college students' physical exercise and mental health research.

There are two statistical methods for analyzing such research designs from a methodological perspective. One is exercise effect method, that is, paired sample T test is applied to the difference of normal distribution between pre-test and post-test data. The other is based on covariance analysis. Before the intervention factors are applied, the psychological indicators of the subjects in the control group and the experimental group are taken as covariates, and the psychological indicators of the subjects in the control group are taken as independent variables. After the intervention factors were applied, the psychological indicators of the subjects in the control group and the experimental group were taken as dependent variables. The differences between the control group and the experimental group before the test were compared, and the specific effects of independent variables on dependent variables were analyzed. This method requires that the measured data must satisfy the hypothesis of parallelism, homogeneity test of variance and normal distribution.

#### **(2) Multiple one-way ANOVA tests**

In the process of processing statistical data, when there are many factors affecting the independent variables in the experiment, the T test which will expand the type I error should not be used to test the effect of the independent variables. Therefore, variance analysis has become the main test method. In method selection, variance analysis and T test are different. However, when there are many independent variables to be faced and the number of independent variables themselves is large, the design of 2 x 3 x 3 subjects is no longer suitable for the statistical method of variance analysis. If we continue to use this method, the research efficiency will be significantly reduced. Therefore, in view of the fact that there are many factors and a large number of independent variables, the multivariate analysis of variance can be considered when choosing the statistical processing method. In addition, the level of independent variables and the number of independent variables are not without optimum limits. Usually, three independent variables are ideal, so the design of subjects can also be used in the form of 2 x 3 x 3. When there are many levels of independent variables and the number of independent variables is too large, the factors will interfere with each other, making statistical analysis difficult to carry out [13].

### **4. Experiments and Analysis of the Effects of Physical Exercise and Mental Health on College Students**

Taking the students of Physical Education Department of a university as the research object, 182 female students and 170 male students were randomly selected according to their gender, totaling 352.

Because there is no obvious difference in individual conditions before the experiment, it is basically at the same level, so the experiment can adopt random sampling method, divide the training intensity into three levels: small, medium and large, and control the continuous training time within 8 weeks. The students in the experimental group need to exercise three times a week for 20 minutes each time, while the students in the control group use self-study instead of exercise. When controlling the training intensity of the students in the experimental group, the heart rate index can be taken as a reference.

In order to improve the accuracy of students' mental health, the Mental Health Testing (MHT) was used to measure the relevant indicators. After a certain degree of training, the test results of the experimental group and the training group show great differences. Because physical exercise consumes a lot of energy, it can effectively control the

intensity of exercise, strengthen students' psychological feeling, and at the same time, enhance the pleasure of sports to students. MHT is used to test the mental health of the students after the training experiment, and the analysis report of the following experimental results can be obtained.

Firstly, the exercise sensation of the subjects in the experimental group was compared under different intensity. The study found that the intensity of physical exercise is different, and there are also obvious differences in the sense of spiritual revitalization, quietness, fatigue and active participation after individual exercise. The specific data are shown in Table 1.

Table 1 List of EFI mean and standard deviation of subjects in experimental group and control group after participating in different intensity exercises

	control group (n=114)						experience group (n=154)					
A sense of refresh ment (A)	4 .09	2 .65	7 .62	2 .46	6 .24	1 .55	5 .94	2 .55	8 .22	2 .30	5 .19	2 .60
Q uietnes s (B)	4 .03	1 .70	4 .76	2 .55	4 .63	2 .21	4 .75	2 .02	5 .47	2 .01	4 .96	2 .11
Fa tigue (C)	7 .61	1 .87	3 .68	2 .79	2 .97	2 .52	3 .73	2 .68	3 .92	2 .19	5 .67	2 .97
A sense of active particip ation (D)	4 .18	4 .18	7 .81	1 .97	5 .54	2 .30	7 .15	2 .91	7 .41	5 .24	2 .57	2 .57

Secondly, under the same intensity, the exercise sensation of the subjects in the experimental group was compared. The results show that moderate intensity of training has no effect on students' sense of spiritual invigoration, quietness, fatigue and active participation; when the intensity of training increases, students' sense of spiritual invigoration, quietness, fatigue and active participation begin to show significant differences. It can be seen that, with the growth of students' age, boys have more advantages in carrying out intensive training. That is to say, boys are more suitable for intensive physical training than girls.

Thirdly, the mental health of the subjects in the control group and the experimental group was compared before and after the experiment. In this experiment, the difference between the control group and the experimental group can be obtained by T test. Through practical comparison, it can be found that the students who participate in exercise have better mental health than those who do not participate in exercise. It can be further confirmed that previous studies, that is, proper physical exercise, can improve the blood circulation of the human body and reduce the degree of overreaction of the human body, so as to effectively improve the psychological and emotional state of the human body and promote the physical and mental harmony and health of the human body.

### Epilogue

Prediction and control are the ultimate goal of scientific research, and the exploration of causality can only be achieved through experimental research. From the perspective of methodology, this paper analyses and discusses the relationship between College Students' participation in physical exercise and their overall mental health. Methodological problems in scientific research involve not only the obtaining of reliable results, but also the verification of experimental results, which is an important feature of research with scientific attributes. Through experimental research, this paper finds that college students' participation in physical exercise is related to their overall mental health level, and the effect relationship between them involves the selection and determination of variables, the design of research methods and the statistical processing of data, and points out the future research directions. That is to say, on the basis of the above-mentioned problems, we use methodologies to explore deeper problems and explore common third variables, such as adjusting variables and mediating variables, which may have an impact on the mechanism of College Students' physical exercise and mental health effects.

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