

# The Relationship between Physical Exercise and Sleep Quality Among Chinese College Students: Mobile Phone Addiction as a Mediator

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**Abstract:** *This study investigated the direct and indirect effects of physical exercise on sleep quality of Chinese college students and the intermediary role of mobile phone addiction. A convenience sampling method was used to select 1522 university students, who completed the Physical Exercise Questionnaire, Mobile Phone Addiction Index Scale and Pittsburgh Sleep Quality Index Scale. Pearson correlation analysis and bootstrap methods were used to examine the intermediary role of mobile phone addiction between physical exercises and sleep quality. There was a significant negative correlation between physical exercise and sleep quality ( $r = -0.39$ ,  $p < 0.01$ ), whereas sleep quality was positively correlated with mobile phone addiction ( $r = 0.53$ ,  $p < 0.01$ ). Physical exercise was a negative predictor of sleep quality ( $b = -0.28$ ,  $p < 0.01$ ), and mobile phone addiction was a mediator between physical exercise and sleep quality; the mediating effect explained 53.6% of the total effect. Thus, mobile phone addiction plays an intermediary role between physical exercise and sleep quality among Chinese college students.*

**Keywords:** *Chinese college students, Sleep quality, Physical exercise, Mobile phone addiction*

## 1. Introduction

Sleep is the guarantee of human health. "2020 China Sleep Quality Survey Report" shows that 67.24% of respondents often suffer from sleep problems. This suggests that sleep quality is becoming a social problem. At the same time, a survey shows that the physical condition of college students is declining year by year, the situation is not optimistic.[1] College students, as excellent reserve resources for social development, their physical and mental health problems cannot be ignored. The study found that college students have significant sleep quality problems.[2] A survey shows that college students, the existence of sleep problems higher than the general population, and focus on mild sleep problems. [3] 27.6% of college students have poor sleep quality.[4] To study the relationship between physical exercise and sleep quality is an important task for psychology to serve and improve people's livelihood. Therefore, the research on the relationship mechanism between physical exercise and sleep quality has attracted more and more attention in psychology and sports science.[5] The purpose of this study was to explore the internal relationship between physical exercise and sleep quality of college students, and to provide theoretical and practical basis for the intervention of physical exercise on sleep quality in practice.

### 1.1. Physical Exercise and Sleep Quality

Physical exercise can be associated with sleep quality. Sleep quality can affect college students' daily life. Research has shown that college students' sleep quality can be predicted by the amount of physical activity they involved in. Physical exercise has even become self-intervention for individuals with sleep disorders. For example, Kredlow et al. used meta-analysis results show that regular exercise has a moderate effect on improving sleep quality, and physical exercise has an obvious promoting effect on sleep quality.[6] Yang Jun et al. found that the sleep quality of senior high school students who lack exercise is generally poor. Physical exercise can affect the sleep quality of students by improving their psychology and increasing their melatonin secretion.[7] Based on biological evidence and theory, this study hypothesized that physical exercise can predict sleep quality of college students.

### 1.2. Physical Exercise, Mobile Phone Addiction, and Sleep Quality

Mobile phone addiction may play an intermediary role between physical exercise and sleep quality among Chinese college students. Mobile phone addiction refers to the abnormal mental behavior caused by the repeated use of certain functions of mobile phones. When the use of mobile phones is reduced or stopped, withdrawal reaction will occur, strong desire to use mobile phones again, accompanied by mental and physical symptoms. [8] A study found that college students' sleep quality can be predicted by how much they rely on their phones. For example, Sara Thome et al. found that mobile phone addiction can even predict sleep quality one year later.[9] Studies related to mobile phone addiction have also confirmed that the increase of mobile phone addiction is often accompanied by a decrease in sleep quality.[10][11] Therefore, mobile phone addiction may reduce the sleep quality of college students.

The benefits of physical exercise to the development of physical and mental health have been proved by a large number of studies, but also widely recognized in the world. At the same time, the World Health Organization and the American Academy of Sports Medicine also put forward the idea of "Exercise is Medicine". Research shows that physical exercise can improve the degree of mobile phone addiction of college students. [12] Proper physical exercise can divert college students' attention to mobile phones and reduce their mobile phone use time, at the same time, it can also improve the level of self-control of college students and further resist the temptation of mobile phones.[13] Hence, the relationship between physical exercise and sleep quality may be mediated by mobile phone addiction.

### 1.3. The Present Study

Based on these empirical and theoretical studies, this study incorporated mobile phone addiction into the mediation model to explore the direct and indirect effects between physical exercise and sleep quality. The following hypotheses were tested.

H1: Physical exercise negatively predicts sleep quality among Chinese college students.

H2: The relationship between physical exercise and sleep quality is mediated by mobile phone addiction.

The hypothesized model is shown in Figure 1.

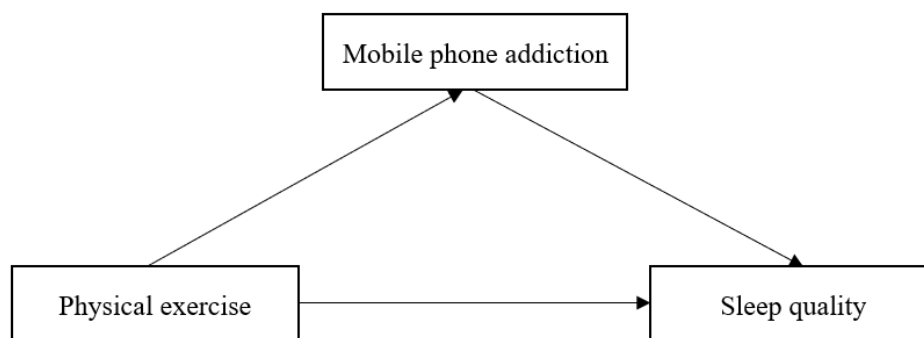


Figure 1: Hypothesis model.

## 2. Materials and Methods

### 2.1. Procedures and Participants

This study was performed in accordance with the Declaration of Helsinki and approved by the institutional review board of the Huaibei Normal University in response to the involvement of minimal risk and anonymous survey procedures. Prior to the survey, all respondents were informed that the study was anonymous and filled out informed consent forms. The subjects were college students and teachers with relevant training, and they were introduced to the survey guidelines. Then, the questionnaires were sent to the respondents through the platform "Questionnaire Star". Finally, all data were imported into SPSS for analysis.

A total of 1522 questionnaires were distributed to Huaibei Normal University, Huaibei Institute of Technology, Sichuan Normal University, South China Normal University and Northeast Normal

University by convenient sampling method, and 1369 effective questionnaires were received (response rate: 89.9%). The sample consisted of 701 male (51.2%) and 668 female respondents (48.8%), with an average age of 20.1 years ( $SD=1.12$ ). Participants slept an average of 6.74 hours a day.

## **2.2. Measures**

### **2.2.1. Physical Exercise**

Using the questionnaire of physical exercise for college students revised by Wu Zhouyang,[14] The questionnaire was adapted from the physical exercise commitment intention scale compiled by Chen Shanping et al.[15] The scale has good reliability and validity for Chinese college students. Physical exercise questionnaire contains 8 questions that address topics including physical exercise commitment and physical exercise persistence. Responses are obtained using a 5-point scale (1= not at all, 5 = very much). The higher the score, the higher the level of physical exercise. The Cronbach's  $\alpha$  of the scale was 0.872 in the present study.

### **2.2.2. Mobile Phone Addiction**

Mobile phone addiction was measured using the Mobile Phone Addiction Index (MPAI) scale compiled by Leung.[16] The MPAI scale contains 17 questions that address topics including out of control, withdrawal, avoidance and inefficiency. Responses are obtained using a 5-point scale (1 = not at all and 5=always). The higher the score, the more serious the participant's phone addiction. The Cronbach's  $\alpha$  of the scale was 0.863 in the present study.

### **2.2.3. Sleep Quality**

Sleep Quality was measured using the Pittsburgh Sleep Quality Index (PSQI) scale compiled by Buysse et al.[17] Liu Xianchen et al. translated and tested its reliability and validity. This scale is widely used to measure the sleep quality of Chinese college students, and has good reliability and validity.[18] The PSQI scale contains 18 questions that address topics including subjective sleep quality, time to fall asleep, time to sleep, sleep efficiency, sleep disorders, hypnotics, and daytime dysfunction. Responses are obtained using a 3-point scale (1 = easy and 5= very difficult). The higher the score, the worse the individual's sleep quality. The Cronbach's  $\alpha$  of the scale was 0.752 in the present study.

## **2.3. Data Analysis**

Data analyses were performed using SPSS 21.0 and PROCESS. Descriptive statistics and correlational analyses were performed for the main variables, and examine the mediating effects of mobile phone addiction on the relationship between physical exercise and sleep quality.

## **3. Results**

### **3.1. Common-Method Bias**

The data obtained by questionnaire survey often have the problem of common method deviation and have a bad effect on the results of the study. Therefore, we examined common method biases in this study were using the Hamann single-factor method. The analysis revealed that the eigenvalues of 8 factors in the principal components analysis were greater than 1 and the first factor accounted for only 28.24% of the variance. Therefore, there were no serious common methodological biases in this study.

### **3.2. Descriptive Statistics and Correlational Analysis**

The results of correlation analysis and descriptive analysis are shown in Table 1. There was a significant negative correlation between physical exercise and sleep quality, whereas sleep quality was positively correlated with mobile phone addiction.

### **3.3. The Mediating Role of Mobile Phone Addiction**

The present study used the Model 4 of the PROCESS macro to test H2 and ascertain whether mobile phone addiction mediates the link between physical exercise and sleep quality. The results showed a negative correlation between physical exercise and mobile phone addiction ( $b = -0.48$ ,  $p < 0.01$ ), while mobile phone addiction was positively correlated with sleep quality ( $b = 0.32$ ,  $p < 0.01$ ).

Physical exercise has a significant direct predictive effect on sleep quality. The residual direct effect was also significant ( $b = -0.13$ ,  $p < 0.01$ ). These results indicated that the relationship between physical exercise and sleep quality was partially mediated by mobile phone addiction (indirect effect =  $-0.15$ , 95% CI =  $-0.22$  to  $-0.10$ ). Overall, this model accounted for 53.6% of the variance in sleep quality, supporting H2.

*Table 1: The Mean, Standard Deviation and the Correlation Coefficient among the Variables*

Variables	M	SD	PE	SQ	MPA
PE	3.84	0.93	1		
SQ	6.21	3.12	-0.39**	1	
MPA	2.93	0.62	-0.41**	0.53**	1

Notes: \*\* $p < 0.01$ .

Abbreviations: PE, physical exercise; SQ, sleep quality; MPA, mobile phone addiction.

#### 4. Discussion

This study proposed that mobile phone addiction would mediate the relationship between physical exercises and sleep quality. Specifically, the increase of physical exercise can effectively reduce the degree of mobile phone dependence, and improve the sleep quality of college students, relieve sleep disorders. Mobile phone addiction independently accounted for part of the association between physical exercise and sleep quality. These results underscore the importance of mobile phone addiction as potential factor in explaining the relationship between physical exercise and sleep quality among Chinese college students. This study is the first to suggest that mobile phone addiction plays a role in this association.

##### 4.1. Relationship between Physical Exercise and Sleep Quality

This study found a significant negative correlation between physical exercise and sleep quality, which supports H1 and is consistent with previous research results.[19] On the one hand, physical exercise can boost the production of melatonin, which in turn helps sleep.[20] On the other hand, a moderate amount of physical exercise will raise one's body surface temperature to a higher level, delaying the drop in body temperature. At the same time, when the body temperature drops at night, it can also drop to a lower level than the original, making people feel tired more easily. Therefore, proper physical exercise can improve the sleep quality of college students.

##### 4.2. The Mediating Role of Mobile Phone Addiction

This study found that mobile phone addiction plays an intermediary role between physical exercise and sleep quality; this suggests that phone addiction is a key factor in the mechanism that predicts sleep quality. According to technology addiction theory, the essence of technology addiction is the overuse of technology.[21] Teenagers addicted to mobile phones will use them excessively and out of control.[16] Mobile phones may be banned in classrooms due to heavy academic commitments during the day,[22] many teens may overuse their phones before going to bed at night, leading to less sleep. In addition, the blue light emitted by mobile devices such as mobile phones at night interferes with the brain's production of the sleep-related hormone (melatonin). Affect the normal blood flow and functional metabolism of the brain. They all have a negative impact on the sleep quality in adolescents. Physical exercise can also reduce loneliness, anxiety, boredom and other negative emotions. Kim's research shows that negative emotions are an important influence factor of mobile phone addiction. In the process of college students' physical exercise, they participate in all kinds of sports, and their technical difficulties, artistic modeling, tacit cooperation and so on make the students' physical and mental pleasure, become an important part of college students' daily spare time life, and greatly meet the spiritual needs of college students. Therefore, we can think that the entertainment function of physical exercise has replaced the entertainment function of college students addicted to mobile phones. On the other hand, by participating in physical exercise, college students in their own like and good at sports, understanding by completing technical movements, companion, wit and conquer the difficulties in the process of the competition, have strong self-confidence, pride and a sense of accomplishment, and enrich the college students' emotional experience, compared with mobile phone addiction produced by negative, bad mood, And the guilt of wasting time obsessing over your phone. Exercise produces a

strong sense of confidence, pride, and a positive sense of accomplishment, which is what exercise is all about. Therefore, proper physical exercise can relieve the degree of mobile phone addiction. Hence, the relationship between physical exercise and sleep quality may be mediated by mobile phone addiction.

## 5. Conclusion

Physical exercise has a significant negative predictive effect on sleep quality among Chinese college students. The relationship between physical exercise and sleep quality was mediated by mobile phone addiction. Our study suggests that increasing physical activity and reducing mobile phone addiction can help students sleep better.

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