Scientific Research Publishing

Health, 2024, 16, 459-469
https://www.scirp.org/journal/health
ISSN Online: 1949-5005
ISSN Print: 1949-4998

A Problem Not to Be Ignored: The Influencing Factors of Mobile Phone Addiction and Its Influence on Sleep Quality

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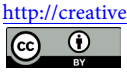
How to cite this paper: Ji, Z.H. and Zhou, L. (2024) A Problem Not to Be Ignored: The Influencing Factors of Mobile Phone Addiction and Its Influence on Sleep Quality. *Health*, **16**, 459-469.
https://doi.org/10.4236/health.2024.165032

Received: October 30, 2023
Accepted: May 19, 2024
Published: May 22, 2024



Abstract

Background and Objective: With the popularity and widespread use of mobile phones, the effects of mobile phone dependence and addiction on individuals' physical and mental health have attracted more and more attention. The present study aims to analyze the current state of mobile phone addiction and its impact on sleep quality within the population, while also exploring the influence of related factors on sleep quality. Ultimately, this research will provide a scientific foundation for targeted intervention measures and strategies. **Methods:** A total of 253 permanent residents in Nanjing were randomly selected as study subjects. The Mobile Phone Addiction Index (MPAI) and Pittsburgh Sleep Quality Index (PSQI) were used to evaluate the degree of smartphone addiction and sleep quality of the study subjects. Body mass index (BMI) was measured according to standardized procedures. Independent sample t-test, Chi-square test, rank sum test and multiple linear regression were used to analyze the correlation between mobile phone addiction and sleep quality, and $P < 0.05$ was considered statistically significant. **Results:** 117 people (46.2%) were addicted to mobile phones. Chi-square test showed that the rate of mobile phone addiction in drinking group was significantly higher than that in non-drinking group ($P < 0.05$). Rank-sum test results showed that the total score of mobile phone addiction was significantly different between the drinking group and the non-drinking group ($P < 0.05$). Independent sample T-test results showed that the scores of sleep time ($P < 0.05$) and sleep efficiency ($P < 0.05$) in the mobile phone addiction group were significantly higher than those in the non-mobile phone addiction group. Multiple linear regression showed that abstinence had significant effect on the total quality after

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adjusting for sex, smoking and drinking ($P < 0.05$). Hierarchical multiple linear regression showed that, Women in the withdrawal of PSQI scores had significant meaning ($P < 0.05$), not smoking withdrawal sex ($P < 0.05$), and inefficiency ($P < 0.05$) had significant significance on PSQI total score. Abstinence factor had significant effect on the total score of sleep quality in the drinking group ($P < 0.05$) and the non-drinking group ($P < 0.05$). **Conclusion:** Mobile phone addiction may lead to shorter sleep duration and reduce sleep efficiency. The withdrawal of mobile phone addiction may have a negative impact on sleep quality. According to the characteristics of the population, appropriate comprehensive intervention measures should be taken to build an effective evaluation system, so as to reduce the impact of mobile phone addiction and withdrawal problems on sleep and improve sleep quality.

Keywords

Mobile Phone Addiction, Influencing Factors, Withdrawal, Sleep Quality

1. Introduction

With the popularity of mobile phones and the trend of younger people, the problem of mobile phone over-dependence has gradually attracted the attention of the public. More and more evidence shows that excessive use of mobile phones may cause mobile phone addiction. The so-called mobile phone addiction refers to a kind of behavioral addiction in which individuals use smartphones excessively and cannot control the behavior, which leads to impaired social function and psychological and behavioral problems [1] [2]. It has been reported that the phenomenon of mobile phone addiction worldwide presents different prevalence rates in different regions and populations, and there are significant differences in the rate of adolescent mobile phone addiction in different regions [3] [4]. Adolescent smartphone addiction has become a challenging public health problem. At the same time, mobile phone addiction has been regarded as one of the possible causes of depression and other mental health problems [5] [6], and it is also closely related to sleep quality [7] [8]. Therefore, it is necessary to understand the current situation and risk factors of mobile phone addiction in the population, and take effective measures to reduce the incidence of mobile phone addiction in this population. This paper aims to further explore the relationship between mobile phone addiction and sleep quality, analyze the possible influencing factors and propose intervention measures.

2. Subjects and Methods

2.1. Subjects

An online questionnaire survey was conducted among permanent residents in Nanjing, Jiangsu Province. A total of 268 questionnaires were collected, of which

253 (94.4%) were valid, 71 males (28.1%) and 182 females (71.9%).

2.2. Methods

2.2.1. Investigation of Population Characteristics

The development of a comprehensive information questionnaire was achieved through an extensive review of relevant literature both domestically and internationally, combined with practical research experience. The survey content included demographic information such as gender, age, residential area, annual household income, and other basic details. BMI is the body mass index, which is an important standard used in the world to measure the degree of obesity. BMI is the body mass index, which is an important standard to measure the degree of obesity in the world, The calculation formula is BMI = weight (kg)/height $(m)^2$. Among these variables, individuals with BMI < 18.5 were classified as underweight, those with BMI between 18.5 and 23.9 were considered normal weight, while individuals with a BMI ranging from 24 to 27.9 were categorized as overweight; those with BMI > 28 were classified as obese. Smoking was defined as the consumption of at least one cigarette per day for six consecutive years. Drinking was defined as consuming alcohol at least twice a week for half a year or longer. Physical exercise was defined as engaging in sessions lasting at least 10 minutes.

2.2.2. Mobile Phone Addiction Index Survey

The Mobile Phone Addiction Index (MPAI), developed by Leung Yongchi from the Chinese University of Hong Kong, was utilized to assess the level of mobile phone addiction within the general population. The scale comprises 17 items, each offering 5 choices ranging from never (1) to always (5). The scale has four dimensions: withdrawal, loss of control, inefficiency and avoidance. Withdrawal refers to the individual's inability to adapt to the adverse emotional reactions that occur when the mobile phone is not used normally. Out-of-control refers to the inability of individuals to control the amount of time they spend on their phones. Inefficiency refers to low learning or work efficiency caused by excessive use of mobile phones; Escapism refers to the use of mobile phones to escape from the real world, the user immersed in the mobile phone network world. The withdrawal items comprised of 8, 9, 10, and 11; the out-of-control items encompassed 1 to 7; the inefficiency items consisted of 15, 16, and 17; while the avoidance items included numbers 12 to 14. If a respondent scored four or more points on eight or more out of the seventeen questions, they were classified as having mobile phone addiction.

2.2.3. Sleep Quality Index Survey

The Pittsburgh Sleep Quality Index (PSQI) was developed in 1989 by Dr. Buysse *et al.*, a psychiatrist at the University of Pittsburgh, and comprises 19 items that are categorized into seven dimensions: subjective sleep quality, sleep onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each item is scored on a scale from 0 to 3 with

the sum of scores across all dimensions representing the total PSQI score; higher scores indicate poorer sleep quality. The sleep quality of individuals scoring 0 - 5 was classified as very good, while those scoring 6 - 10 were categorized as having fair sleep quality. Individuals with scores ranging from 11 - 15 were considered to have average sleep quality, whereas those scoring 16 - 21 were identified as experiencing very poor sleep quality.

2.3. Data Processing and Statistical Methods

The questionnaires were completed exclusively by trained professionals. Excel software was utilized for the purpose of data entry and verification, while SPSS software (Version 20.0) was employed for statistical analysis. Continuous variables conforming to a normal distribution were presented as mean ± standard deviation, whereas categorical variables were expressed as constituent ratio or rate. The χ^2 test was used for comparison between groups and categorical variables, independent sample t test (satisfying normal distribution) was used for continuous variables, and rank sum test was used for continuous variables not satisfying normal distribution or with uneven variance. Taking gender, smoking and drinking as adjustment factors, each dimension of mobile phone addiction as independent variable, and PSQI total score as dependent variable, multiple linear regression model was used to estimate the regression coefficient and 95% confidence interval (95% CI) of each related factor. All data analyses were two-sided, A difference of $P < 0.05$ was considered statistically significant.

3. Result

3.1. General Characteristics of Population

There were 136 (53.8%) non-addicted and 117 (46.2%) addicted to mobile phones. There were 71 males, among whom 34 (29.1%) were mobile phone addicts, and 182 females, among whom 83 (70.9%) were mobile phone addicts. The average age of the total population was 35.36 ± 8.68 years old, and 87 people (74.4%) were addicted to mobile phones between 20 and 39 years old. By analyzing the general characteristics of the addiction group and the non-addiction group, it was observed that the mobile phone addiction group exhibited a significantly higher drinking rate compared to the non-mobile phone addiction group ($P < 0.05$). The other characteristics, including age, gender, residence area, family income, physical exercise, smoking habits, medical education background, BMI grouping and education level did not show any statistically significant differences between the mobile phone addiction group and the non-addiction group ($P > 0.05$) (Table 1).

3.2. Distribution of Total Score of Mobile Phone Addiction in General Characteristics

The rank total score of mobile phone addiction between the drinking group and the non-drinking group were 25,209, and the differences between the groups

were significant ($P < 0.001$), while the total score of mobile phone addiction among the other characteristics showed no statistical difference ($P > 0.05$) (Table 2).

Table 1. Comparison of general characteristics of population and addiction of mobile phone.

item	Classification	n	Non-mobile phone addiction	Mobile phone addiction	*P*
Total N (%)		253	136 (53.8)	117 (46.2)	
age		35.36 ± 8.68	36.51 ± 9.48	34.03 ± 7.45	0.683
	20 - 39	179 (70.8)	92 (67.6)	87 (74.4)	0.488
	40 - 59	71 (28.1)	42 (30.9)	29 (24.8)	
	>60	3 (1.2)	2 (1.5)	1 (0.9)	
Gender	male	71 (28.1)	37 (27.2)	34 (29.1)	0.743
	female	182 (71.9)	99 (72.8)	83 (70.9)	
Area of residence	Rural areas	37 (14.6)	19 (14.0)	18 (15.4)	0.907
	City	185 (73.1)	101 (74.3)	84 (71.8)	
	Township	31 (12.3)	16 (11.8)	15 (12.8)	
annual household income	<50,000	25 (9.9)	12 (8.8)	13 (11.1)	0.573
	50,000 - 100,000	46 (18.2)	24 (17.6)	22 (18.8)	
	100,000 - 200,000	78 (30.8)	48 (35.3)	30 (25.6)	
	200,000 - 300,000	59 (23.3)	29 (21.3)	30 (25.6)	
	>300,000	45 (17.8)	23 (16.9)	22 (18.8)	
physical exercise	no	65 (25.7)	34 (25.0)	31 (26.5)	0.205
	once or twice a week	112 (44.3)	60 (44.1)	52 (44.4)	
	three to four times a week	52 (20.6)	33 (24.3)	19 (16.2)	
	>5 times	24 (9.5)	9 (6.6)	15 (12.8)	
smoking	no smoking	223 (88.1)	123 (90.4)	100 (85.5)	0.223
	smoking	30 (11.9)	13 (9.6)	17 (14.5)	
drinking	no drinking	211 (83.4)	120 (88.2)	91 (77.8)	0.026
	drinking	42 (16.6)	16 (11.8)	26 (22.2)	
Medical professional education	yes	192 (75.9)	99 (72.8)	93 (79.5)	0.215
	no	61 (24.1)	37 (27.2)	24 (20.5)	
BMI Categories	underweight	22 (8.7)	10 (7.4)	12 (10.3)	0.461
	normal	164 (64.8)	88 (64.7)	76 (65)	
	overweight	45 (17.8)	23 (16.9)	22 (18.8)	
	obesity	22 (8.7)	15 (11.0)	7 (6.0)	
Level of education	Junior high school and below	22 (8.7)	12 (8.8)	10 (8.5)	0.308
	High school/technical secondary school	20 (7.9)	14 (10.3)	6 (5.1)	
	University and above	211 (83.4)	110 (80.9)	101 (86.3)	

Table 2. Distribution of total score of mobile phone addiction in general characteristics.

item	Classification	n	Ratio of composition (%)	H	*P*
Gender	male	71	28.1	22347.5	0.143
	female	182	71.9		
Area of residence	Rural areas	37	70.8	1.303	0.521
	City	185	28.1		
	Township	31	1.2		
annual household income	<50,000	25	14.6	4.118	0.390
	50,000 - 100,000	46	73.1		
	100,000 - 200,000	78	12.3		
	200,000 - 300,000	59	9.9		
	>300,000	45	18.2		
physical exercise	no	65	30.8	4.697	0.195
	once or twice a week	112	23.3		
	three to four times a week	52	17.8		
	>5 times	24	25.7		
smoking	no smoking	223	44.3	27751	0.130
	smoking	30	20.6		
drinking	no drinking	211	9.5	25209	0.000
	drinking	42	88.1		
Medical professional education	yes	192	11.9	6880	0.082
	no	61	83.4		
BMI Categories	underweight	22	8.7	3.633	0.304
	normal	164	64.8		
	overweight	45	17.8		
	obesity	22	8.7		
Level of education	Junior high school and below	22	8.7	2.517	0.284
	High school/technical secondary school	20	7.9		
	University and above	211	83.4		
age	20 - 39	179	70.8	1.632	0.442
	40 - 59	71	28.1		
	≥60	3	1.2		

3.3. The Relationship between the Dimensions of Mobile Phone Addiction and Sleep Quality

The scores of sleep onset time and sleep efficiency were significantly higher in the mobile phone addiction group compared to the non-mobile phone addiction group ($P < 0.05$) (Table 3). Taking the scores of each dimension of mobile phone addiction as the independent variable, the total score of sleep quality as

Table 3. Comparison between dimensions of mobile phone addiction and sleep quality.

Item	PSQI total score	Sleep quality	Sleep onset time	Sleep duration	Sleep efficiency	Sleep disorders	Sleep medications	Daytime dysfunction
Mobile phone Addiction	6.15 ± 2.84	0.89 ± 0.83	1.03 ± 0.87	0.80 ± 0.56	0.65 ± 0.98	1.09 ± 0.55	0.31 ± 0.61	1.38 ± 0.91
Non-mobile phone addiction	5.86 ± 3.61	1.04 ± 0.82	0.76 ± 0.78	0.76 ± 0.56	0.42 ± 0.71	1.05 ± 0.71	0.41 ± 0.91	1.40 ± 0.10
t	0.70	−1.49	2.59	0.55	2.12	0.42	−1.09	−0.24
P	0.48	0.14	0.01	0.59	0.04	0.68	0.28	0.82

Note: Independent sample t-test was used.

the dependent variable, and selecting gender, smoking and drinking as adjustment variables, multiple linear regression analysis showed that withdrawal ($P < 0.05$) had a linear relationship with total sleep quality score (Table 4). After conducting a stratified analysis for each adjustment factor, it was found that abstinence in females had a statistically significant impact on the overall PSQI score ($P < 0.05$). In the non-smoking group, abstention ($P < 0.05$) and inefficiency ($P < 0.05$) had significant significance on the total score of PSQI. The association between abstinence and the total score of sleep quality was statistically significant in both the drinking group ($P < 0.05$) and the non-drinking group ($P < 0.05$) (Table 5).

4. Discussion

The smartphone, as an indispensable tool in modern life, has increasingly become a vital component of individuals' lives, encompassing their education, work, and leisure activities. However, excessive reliance or addiction to its use can lead to a range of issues. Among these concerns is the significant impact it has on sleep quality—an aspect that warrants public attention and vigilance.

The findings of this study indicate that the prevalence rate of mobile phone addiction in the general population reaches as high as 46.2%, which aligns with the research conducted by Yu Zengyan *et al.* [9]. As smart phones continue to gain popularity and their functionalities gradually improve, individuals are increasingly developing a reliance on them. According to the study conducted by Sahin *et al.* [10], individuals who acquire their first mobile phone before the age of 13 exhibit the highest levels of problematic use or addiction. This phenomenon may be attributed to cognitive, emotional, and social development during adolescence, which increases susceptibility to smartphone dependence. The higher the levels of life and academic pressure, the more pronounced the inclination towards smartphone addiction becomes. Research conducted abroad indicates a positive correlation between psychological stress and smartphone addiction, with social pressure, familial pressure, and emotional strain having a predictive impact on smartphone addiction [11]. Psychological stress during adolescence is a key factor in smartphone addiction, which has a certain relationship with the

Table 4. Multiple linear regression analysis of dimensions of mobile phone addiction and sleep quality.

Independent variable	SE	β (95% CI)	P
(constant)	1.551	2.667 (−0.388, 5.722)	0.087
Loss of control	0.052	0.000 (−0.102, 0.102)	0.998
withdrawal	0.074	0.239 (0.094, 0.384)	0.001
Avoidance	0.097	−0.087 (−0.277, 0.103)	0.368
inefficiency	0.110	−0.213 (−0.430, 0.003)	0.053

Note: Multiple linear regression models were used, adjusting for gender, smoking, and alcohol consumption

Table 5. The correlation between the scores of each dimension of mobile phone addiction and sleep quality in gender, smoking and drinking factors.

Item (PSQI total score)			Loss of control	withdrawal	Avoidance	inefficiency
Gender factor	Male	β (95% CI)	−0.036 (−0.262, 0.189)	−0.010 (−0.344, 0.324)	0.078 (−0.338, 0.494)	−0.007 (−0.470, 0.455)
		P	0.748	0.952	0.709	0.975
	Female	β (95% CI)	−0.274 (−0.603, 0.056)	0.639 (0.149, 1.130)	−0.284 (−0.871, 0.303)	−0.133 (−0.715, 0.499)
		P	0.859	0.000	0.229	0.058
Smoking factor	no smoking	β (95% CI)	0.026 (0.081, 0.132)	0.254 (0.109, 0.399)	−0.093 (−0.289, 0.103)	−0.252 (−0.457, −0.028)
		P	0.636	0.001	0.351	0.028
	smoking	β (95% CI)	−0.177 (−0.618, 0.263)	0.087 (−0.821, 0.994)	0.088 (−0.666, 0.842)	0.125 (−0.859, 1.059)
		P	0.101	0.012	0.333	0.646
Drinking factor	no drinking	β (95% CI)	0.047 (−0.062, 0.156)	0.182 (0.030, 0.333)	−0.039 (−0.239, 0.161)	−0.175 (−0.409, 0.059)
		P	0.397	0.019	0.700	0.142
	drinking	β (95% CI)	−0.274 (−0.603, 0.056)	0.639 (0.149, 1.130)	−0.284 (−0.871, 0.303)	−0.133 (−0.715, 0.499)
		P	0.101	0.012	0.333	0.646

Note: Multiple linear regression analysis, $P < 0.05$ represents a significant difference.

pressure of learning, social relationships and family environment. A variety of strategies can be used to intervene. On one hand, both collective and individual cognitive behavioral interventions can assist adolescents in recognizing and modifying maladaptive thought patterns that contribute to stress, while also guiding them towards adopting effective coping strategies. As a result, these interventions have the potential to alleviate symptoms of anxiety and depression. On the other hand, we need to pay attention to family factors, actively cooperate with parents to provide family treatment and education strategies to overcome the

factors of poor family communication, and educate parents to provide positive emotional support and scientific cultivation methods, so as to reduce the intellectual dependence and addiction of adolescents.

This study shows that drinking alcohol may be an influential factor in mobile phone addiction, which is consistent with relevant foreign studies [12]. Drinking, especially alcohol dependence, has become one of the common public health problems in modern society. According to the survey, the prevalence of alcohol dependence in China has soared from 0.02% in the 1980s to 9% in the early 21st century. Long-term drinking or alcohol dependence can lead to a range of behavioral and psychopsychological reactions, including sociability, sedation, aggression, loss of executive function and cognitive deficits [13] [14]. Individual psychotherapy (cognitive behavioral therapy, behaviorist therapy and short-term psychodynamic therapy), social environment therapy, group psychotherapy (interpersonal psychotherapy) and multiple model therapy or comprehensive psychological intervention can be used to achieve the intervention effect of $1 + 1 > 2$, reduce the number of severe alcohol consumption in the population, maintain abstinence and low dose alcohol consumption. Efforts should be made to minimize reliance on mobile phones and reduce the influence of alcohol addiction as much as possible.

In this study, the scores of sleep time and sleep efficiency in the mobile phone addiction group were significantly higher than those in the non-mobile phone addiction group, and the results were statistically significant, indicating that mobile phone addiction may lead to delayed sleep time and decreased sleep efficiency. The more severe the mobile phone addiction, the worse the sleep quality, which is consistent with relevant research results [15]. The withdrawal of mobile phone addiction has a detrimental impact on sleep quality, potentially contributing to the deterioration thereof. This suggests that the severity of withdrawal symptoms experienced upon smartphone separation is directly proportional to the decline in sleep quality. To address this issue effectively, it is imperative to actively address and rectify individuals' erroneous cognitive beliefs. In terms of usage duration, it is advisable to restrict the utilization of mobile devices, establish a designated period for phone prohibition, and refrain from using electronic gadgets 1 to 2 hours prior to bedtime in order to mitigate the sleep-disrupting effects of blue light and diminish cerebral activity. Regarding mobile phone placement, it is optimal to relocate the device to another room for charging before retiring for the night, thereby reducing nocturnal arousal temptations. For habit modification, individuals are encouraged to explore and engage in alternative non-screen activities, such as reading printed books, practicing meditation, or engaging in moderate physical exercise, as a substitute for using their mobile devices before bedtime. In terms of environmental adjustments, individuals should be guided to establish healthy sleep hygiene practices, maintain a comfortable sleep environment (including appropriate temperature control and light and sound management), develop a consistent sleep schedule, and mitigate the adverse effects of smartphone withdrawal symptoms.

Additionally, the utilization of electronic devices during nighttime hours also exerts an impact on melatonin secretion, subsequently influencing sleep quality. Melatonin serves as a pivotal hormone responsible for regulating circadian rhythms and facilitating sleep, and exposure to light emitted by electronic devices may disrupt its secretion. Wei Sun *et al.* [16] discovered that prolonged usage of electronic products prior to bedtime can diminish the levels of melatonin in urine before sleep. The presence of information related to mobile phones or engaging in gaming activities can elicit feelings of excitement, fear, or anxiety among individuals, leading to heightened psychological and physiological arousal that hinders the ability to fall asleep. Recent studies have revealed a correlation between prolonged gaming sessions before bedtime and increased cortisol secretion, consequently intensifying the level of arousal [17]. Considering the impact of electronic devices on melatonin, it is advisable to utilize "night mode" or "red light mode" when using electronic devices before sleep in order to minimize exposure to blue light and consequently reduce melatonin suppression. Additionally, incorporating techniques such as meditation, deep breathing, or progressive muscle relaxation before sleep can effectively alleviate tension and anxiety while reducing the body's physiological arousal state.

5. Conclusion

The problem of mobile phone addiction and its influencing factors should not be ignored. The withdrawal of mobile phone addiction has a negative impact on the sleep quality of the population. Timely and appropriate intervention measures are helpful to reduce the dependence or addiction of the population on mobile phone and improve the sleep quality. The results of this study have significant reference value due to the involvement of multiple work units and regions. However, there are certain limitations, such as a limited sample size and the cross-sectional nature of the study. In addition, the conclusion of this study highlights the significance of employing mobile phones in a rational manner. To address the issue of excessive reliance on mobile phones, it is imperative to conduct additional research on implementing appropriate intervention measures, evaluating their effectiveness, and garnering public attention.

Acknowledgements

The article comes from Jiangsu Province Key Research and Development Program (BE2022837) and Key Project of Medical Research of Jiangsu Province Health Commission (ZD2022069).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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