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CELL PHONE ADDICTION AND APPS ACTIVITIES AMONG CHINESE MEDICAL STUDENTS: PREVALENCE AND RISK FACTORS

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ABSTRACT

Objective
To investigate the prevalence of cell phone addiction and the association with apps use and preference among medical students in China to offer suggestions for phone addiction prevention and management.

Methods
A total of 3058 medical undergraduate students from six medical universities/colleges located in five provinces of China were randomly sampled and interviewed. An adapted "Questionnaire of Mobile APP" from "Manolis/Roberts Cell-Phone Addiction Scale" was used to conduct the interview. Chi-squared (χ^2) test and binary logistic regression analysis were used for data analysis. A database was built with EpiData 3.1, and statistical analysis was conducted using SPSS 23.0.

Results
Cell phone addiction was reported by 16.25% of medial undergraduates. Univariate analysis found statistical difference among addictive students with different genders, hukou status, monthly cell phone bills and in-love status. The following were reported as the risk factors for mobile addiction among medical students by logistic regression analysis: medical students who were female (odds ratio [OR]=1.704, 95% confidence interval [CI]=1.386, 2.095), were from urban (OR=1.307, 95% CI=1.046, 1.634), had boyfriend or girlfriend (OR=1.333, 95% CI=1.080, 1.646), used reading apps (OR=1.254, 95% CI=1.015, 1.549), were using reading apps (OR=1.254, 95% CI=1.015, 1.549), and were using chat apps (OR=2.222 , 95% CI=1.146, 4.310).

Conclusion

Medical students who are female, from urban, in-love, or frequent users of reading and chat apps may face a higher risk of cell phone addiction. Therefore, gender-specific and app type-specific interventions should be developed to intervene college students' cell phone addiction.

Key Words: *medical students; mobile phone addiction; APP; affect factors*

STRENGTHS AND LIMITATIONS OF THIS STUDY

The study involved medical students from six medical colleges and universities located in five provinces of China, which is a large and nationally representative sample size.

In this study, individual cell phone activities and the related addition potential were investigated in detail from the perspective of apps.

The study did not include the outcome variables caused by cell phone addiction, such as academic performance or mental health status, due to lack of previous research findings.

The questionnaires used in this research relied on self-assessment, and the lack of objective measurement may lead to bias and errors.

INTRODUCTION

The rapid spread of internet and 4G networks has witnessed the fast increase of cell phone users in China. The Ministry of Industry and Information Technology of the People's Republic of China claims that the number of cell phone users in China has increased from 149 million to 1.57 billion, with a penetration of 112.2%.[1] Meanwhile, a full range of services, including instant messaging, electronic payment, online shopping, and entertaining, provided on smartphones by varied applications (apps), has quickly grounded in Chinese people's daily life and fundamentally changed their lifestyle. The coming of 5G era will fasten the changing pace and bring an even tighter association of cell phone use and daily life. Despite convenience and pleasures brought by omnipotent cell phone technologies, the growing dependency and reliance on cell phone use is posting a new social concern: cell phone addition.[2]

The traditional definition of addiction started from substance addiction that fosters physical or mental dependence. Brown et al.[3] define addiction as abuse without control, alterations in mood, tolerance, abstinence, and personal harm or conflicts in the environment, as well as a tendency to relapse. Later, the behavioral addition was separated from substance addiction, and Holden notes it as any compulsive behavior that brings "rewards" or "pleasure" that is concerned with and recognized by the brain.[4] Prior to cell phone addiction, the research on behavioral addictions was devoted to addictions to videogames,[5] online shopping,[6] and the internet use.[7,8] Echeburua et al.[9] highlighted the loss of control, the establishment of a dependent relationship, tolerance, the need for progressively more time and dedication, and severe interference with daily life as the key elements of behavioral addictions.

After the invention of cell phones, especially after the extensive use of smartphones, cell phone was soon considered as a source of potentially addictive behavior.[10,11] Increasing number of researches have devoted to exploring the reasons and risk factors of cell phone addiction.[12] Madrid claims that mobile phone usage is a compulsive and addictive disorder and is to become one of the biggest non-drug addictions in the 21st century.[13] Shambare et al. also consider cell phone addiction to be one of the greatest addictions of the current century.[14] Researchers[15] have summarized six types of behaviors presented in cell phone use, namely habitual (habits performed with little mental awareness), mandatory (officially required or parentally mandated),

voluntary (reasoned and conducted for specific motivations), dependent (motivated by the attached importance of social norms), compulsive (strong urge to continuously perform the behavior), and addictive (progressive exclusion of other activities, causing physical, mental, and social harm). Based on the definition review, this research defines cell phone addiction as a developing process that relies on the time and degree of obsession with cell phone use. Accordingly, two dimensions were adopted as the measurement of cell phone addiction among medical students in this research: excessive attention and reliance on cell phone (degree of agitation when cell phone is not in sight; degree of nervousness when cell phone's battery is almost exhausted) and the uncontrolled time dedication in cell phone use (excessive hours spend on cell phone; tendency of spending more and more time on cell phone).

The further exploration of the risk factors of cell phone addiction leads to research findings and suggestions proposed by multiple disciplines. From the perspective of behavioral science, the addiction may be resulted from personal characteristics, psychiatric conditions, or problematic behaviors,[16,17] while technology science and media studies claim that addiction is caused by contents offered in various cell phone apps.[18] Therefore, this study included personal and behavioral characteristics, as well as cell phone contents and applications, in the analysis.

University students are the major users of smartphones. The previous research demonstrates that they are with unique cell phone use habits which may influence their physical and mental health, social and familial connection, and academic achievement.[19] Similar additive symptoms of university underrates were reported, including impulsiveness, mounting tension prior to using cell phone, failure of time control, displacement of attention to school work, and inability to diminish phone use.[20] Physically,

phone addiction may cause, including rigidity and muscle pain, ocular afflictions,[21,22] while physiologically it will unavoidably lead to anxiety, loneliness, stress, sleeping disorders, and cognition change.[23,24]

Medical undergraduates are a special large group of university student. As reported by *China's Health Statistical Yearbook 2018*, the number of medical students was 2.89 million, accounting for 9.6% of all university students.[25] Medical training is significantly more strict and stressful than other majors, requiring intense concentration, commitment, devotion, and diligence; while cell phone overuse or addition would unavoidably distract them from daily learning and training and may finally handicap their professionalism. Different from the medical education scheme adopted in some developed western countries, Chinese medial students start medical training immediately after high school graduation at a very young age (18–20 years old) and lack strong determination to conduct self-control. It is meaningful to study this group of students, investigate the real prevalence of cell phone addiction, reveal the risk factors of addiction, and design effective intervention plans to do the preventive management. However, very few researchers have paid attention to this field. Therefore, this study is designed to explore the prevalence and risk factors of cell phone addiction among medical students in universities and design practical student management plans.

METHODS

Data and Sampling

Six medical universities/colleges located in five provinces of China (Guangdong, Hubei, Jiangsu, Shanxi, and Hebei) were selected as study sites. Random cluster sampling was used to randomly choose 2–3 classes from different medical sub-disciplines from each university, and the whole class would receive the investigation. All respondents were informed of the purpose of the study, and

those without a cell phone were excluded from the survey. To avoid bias caused by the academic and internship pressure among students in the fourth year and above, only students in the first, second, and third years were included.

The questionnaires were filled up electronically on SOJUMP, an online questionnaire tool. A total of 3100 questionnaires were collected, and 3058 valid questionnaires were received for further analysis (effective rate 98.6%). The investigation was approved by the school ethics review committee and took 3 months to finish.

Questionnaire and Variables

The questionnaire was composed of three sections:

First section comprises the basic information of interviewees. It included gender, age, hometown, monthly living expenses, price of cell phone, and health status;

Second section comprises the cell phone addiction measurement. The Manolis/Roberts Cell-Phone Addiction Scale (MRCPAS) developed by James A. Roberts and Chris[18] was used to investigate the cell phone addiction of medical students. Four items of this scale were adopted to determine cell phone addiction: (1) I get agitated when my cell phone is not in sight. (2) I get nervous when my cell phone's battery is almost exhausted. (3) I spend more time than I should on my cell phone. (4) I find that I am spending more and more time on my cell phone. A 7-grade Likert scale was used to measure the degree of seriousness from "1" the weakest and "7" the strongest. Total score of 20 points or above was considered as cell phone addiction.

Cell phone apps and activities: This section was composed of self-designed questions to investigate students' use of cell phone apps. It covered cell phone apps used by the Chinese public: apps for News and information, film and television, music, reading, communication and chat, online shopping, daily living, financial management, web browsers, camera and photo beatification, navigation, education and learning, business and work, and antivirus and system security. The respondents were asked whether they use a certain type of application and which specific application they use. An example: Which of the following video apps (short for apps) do you use most often? (The respondents were supposed to choose from the following answers.) (1) None, (2) iQIYI, (3) Youku, (4) Soho video, (5) LETV, (6) Tencent video, and (7) Others.

Statistical Analysis

Chi-squared (χ^2) test and logistic regression analysis were used to conduct univariate analysis and multivariate analysis. A value of P<0.05 was considered as statistically significant. The database was built with EpiData 3.1, and statistical analysis was conducted using SPSS 23.0.

RESULTS

Table 1 shows that among the 3058 medical undergraduates participated in the investigation, 16.2% of them reported cell phone addiction. Among the participants, 45.30% were females, 61.90% were from urban area, and 35.1% had a boyfriend or girlfriend. About 97.9% of participants had living expenses lower than 2000 RMB ($292) per month, and 47.40% had living expenses lower than 1000 RMB ($146). Their cell phone purchase and monthly bill were not very high, 69.60% of whom owned cell phone cheaper than 2000 RMB ($292) and 97.78% of them pay less 100 CNY ($14.6) for phone bills.

Table 2 reported the association among personal characteristics and cell phone addiction. Female students (16.72% vs. 12.60%, P<0.001), urban students (17.30% vs. 14.50%, P=0.039), students in a relationship (17.60% vs. 13.70%, P=0.005), and those who pay highest phone bills (25.80% vs. 12.5% vs. 17.3%, P<0.001) all reported higher addition prevalence than their counterparts.

TABLE 1. Basic Demographic Characteristics of the Medical Students Surveyed

Variable		Freq.	%
Gender	Male	1386	45.30
	Female	1672	54.70
Hukou	Rural	1166	38.10
	Urban	1892	61.90
Having girl (or boy) friend	Yes	1073	35.10
	No	1985	64.90
Monthly living expenses	<1000 RMB	1458	47.70
	1000–2000 RMB	1534	50.2
	>2000 RMB	66	2.1
Cell phone price	<1000 RMB	722	23.60
	1000–2000 RMB	1406	46.00
	>2000 RMB	930	30.4
Monthly cell phone bills	<50 RMB	1816	59.40
	50–100 RMB	1032	33.70
	>100 RMB	210	6.90
Cell phone addiction	Yes	497	16.20
	No	2561	83.80

TABLE 2. Comparison of Incidence of Cell Phone Addiction among Medical Students with Different Demographic Characteristics

| Variables		Addiction (Yes)	(%)	χ^2	P
Gender	Male	174	12.60	25.473	<0.001
	Female	323	16.72		
Hukou	Rural	169	14.50	4.281	0.039
	Urban	328	17.30		
Having girl (or boy) friend	No	147	13.70	7.913	0.005
	Yes	350	17.60		
Monthly living expenses	<1000 RMB	226	15.50	2.455	0.653
	1000–2000 RMB	259	16.9		
	>2000 RMB	12	18.2		
Cell phone price	<1000 RMB	125	17.30	6.611	0.158
	1000–2000 RMB	203	14.40		
	>2000 RMB	169	18.10		
Monthly cell phone bills	<50 RMB	314	17.30	25.927	<0.001
	50–100 RMB	129	12.50		
	>100 RMB	54	25.70		
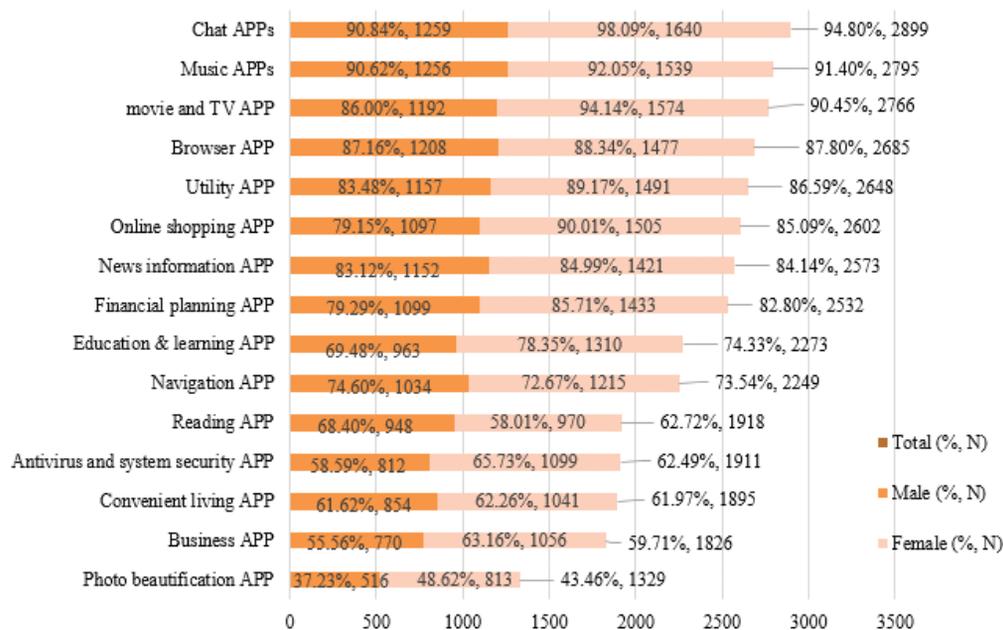
FIG. 1 Types of top-used cell phone apps by medical students.

Figure 1 showed the most used types of apps by medical students. The top five types of cell phone apps used by medical students were chat apps (94.8%), music apps (91.4 %), movie and TV apps (90.45%), web browser apps (87.80%), and utility apps (86.59%). Among them, the five most popular cell phone apps among male students include chat apps (90.84%), music apps (90.62%), web browser apps (87.16%), movie and TV apps (86%), and utility apps (83.48%); while the five favorite apps used by female students are chat apps (98.09%), movie and TV apps (94.14%), music apps (92.05%), online shopping apps (90.01%), and utility apps (89.17%).

The association between types of apps and cell phone addiction was shown in Table 3. The frequent users of movie and TV apps (16.80% vs. 11.30%, P=0.016), reading apps (17.40% vs. 14.30% P=0.024), chat apps (16.80% vs. 6.30%, P<0.001), and selfie and makeover apps (18.40% vs. 14.60%, P=0.004) reported higher cell phone addiction compared with medical students who did not use.

Multivariate logistic regression was built to further analyze the influencing factors of cell phone addiction (Table 4). Stepwise method was adopted; and gender, hukou status, whether in relationship, movie and TV apps, reading apps, chat communication apps, and selfie and make-over apps were chosen as the independent variables. The monthly average cell phone bill was excluded to avoid the association with cell phone use frequency and time length. The results showed that medical students who were female (odds ratio [OR]=1.704, 95% confidence interval [CI]=1.386, 2.095), were from urban (OR=1.307, 95% CI=1.046, 1.634), had boyfriend or girlfriend (OR=1.333, 95% CI=1.080, 1.646), and used reading apps (OR=1.254, 95% CI=1.015, 1.549) were more likely to be addicted to cell phone use. The phone activities and apps were also found to be associated with cell phone addiction. The use of chat apps (OR=2.222, 95% CI=1.146, 4.310) and reading apps (OR=1.254, 95% CI=1.015, 1.549) was found to be a positive influencing factor for cell phone addiction.

TABLE 3. Type of Apps Used and the Prevalence of Addiction among Medical Students

Variable		Addiction (%)		χ^2	P
Using News information apps or not	No	81	16.70	0.085	0.770
	Yes	416	16.20		
Using movie and TV apps or not	No	33	11.30	5.814	0.016
	Yes	464	16.80		
Using music apps or not	No	49	18.60	1.196	0.274
	Yes	448	16.00		
Using reading apps or not	No	163	14.30	5.100	0.024
	Yes	334	17.40		
Using utility apps or not	No	75	18.30	1.448	0.229
	Yes	422	15.90		
Using chat communication apps or not	No	10	6.30	12.232	<0.001
	Yes	487	16.80		
Using online shopping apps or not	No	67	14.70	0.958	0.328
	Yes	430	16.50		
Using convenient living apps or not	No	190	16.30	0.010	0.921
	Yes	307	16.20		
Using financial planning apps or not	No	78	14.80	0.946	0.331
	Yes	419	16.50		
Using web browser apps or not	No	51	13.70	2.077	0.150
	Yes	446	16.60		
Using selfie and makeover apps or not	No	252	14.60	8.226	0.004
	Yes	245	18.40		
Using navigation apps or not	No	121	15.00	1.357	0.244
	Yes	376	16.70		
Using education and learning apps or not	No	114	14.50	2.323	0.128
	Yes	383	16.80		
Using business apps or not	No	184	14.90	2.631	0.105
	Yes	313	17.10		
Using antivirus and system security apps or not	No	193	16.80	0.444	0.505
	Yes	304	15.90		

DISCUSSION

This study defines cell phone addiction as uncontrolled time and degree of obsession with cell phone use. It is designed to estimate the prevalence and risk factors of cell phone addiction among medical students. We find that the prevalence of cell phone addiction was 16.2% among medical undergraduates. Gender, hukou status, in-love relationship, and monthly cell phone bills are influencing factors of addiction. In addition, chat apps and reading are addictive

TABLE 4. Binary Logistic Regression Analysis of Factors Affecting Cell Phone

Variable	OR (95% CI)	P
Constant	0.006	<0.001
Sex (male)	1.704 (1.386, 2.095)	<0.001
Hukou (rural)	1.307 (1.046, 1.634)	0.018
In relationship (no)	1.333 (1.080, 1.646)	0.007
Use reading apps (no)	1.254 (1.015, 1.549)	0.036
Using chat apps (no)	2.222 (1.146, 4.310)	0.018
Cell phone price (<1000 RMB)		
1000–2000 RMB	0.874 (0.682, 1.119)	0.284
>2000 RMB	1.296 (0.982, 1.710)	0.067

CI = confidence interval; OR = odds ratio.

to medical students. The findings not only reveal the current cell phone use and addiction situation among Chinese medical student but also offer clues to the design and implementation of management plans.

The prevalence of 16.2% reported in this survey is consistent with the previous findings from 10% to 25%.[26,27] Although no requirements have been set for cell phone addiction for medical students, the prevalence of 16.2% is still considerably high given the specialty and high requirement of medical science training. According to an internet survey, Chinese medical students spend 60–70 hours on study weekly, and the situation gets worse after internship or residency start. On the one hand, the pressure of study and work requires high concentration and efficiency, but meanwhile it may make medical students overloaded or overpressured. On the other hand, cell phones, especially the interesting apps, offer medical students an easy and affordable way of relaxation, entertainment, and sometimes even a sanctuary to the overloaded students. It should have been a good way of relaxation if all medical students are highly self-control. However, some medical students may have difficulty in time control and the unlimited cell phone use may ruin their career. In reality, there should always be management plans to help regulate the behaviors of cell phone use among medical students, and detailed management measures should be taken to help them manage time. Cell phone addiction should be removed as an obstacle from the way of a qualified graduator.[28]

Some demographic characteristics were positively associated with cell phone addiction, indicating interventions should be designed based on comprehensive consideration of gender, hukou background, and whether in relationship.

Female medical students are easier to be addicted to cell phone, which is consistent with previous findings.[18,29] Female students prefer to stay indoors rather than to play outdoors, and some apps, such as chat apps, music apps, movie and TV apps, attract female students more. It was found from this survey that female medical students favor shopping apps most. Shopping itself is an addictive activity and would offer a shelter from heavy learning.[30] The population of online shopping apps as Taobao and JD.com has greatly facilitated the utilization and satisfies their needs of relaxation, but it would also easily extend the time spent on cell phones.[31]

Medical students in romantic relationships are found to have lower capacity of time control and higher level of obsession in cell phone use because they need more communication. It indicates that medical students are not more skilled to control

love and emotion compared with students of other majors even though they are studying medical science. Instead, the studies of Lu, Wang et al. and Zhou have identified that the obsession of cell phone use among medical students in love is higher and is more likely to report psychological problems caused by cell phone addiction.[32,33] Meanwhile, students from the urban areas were more easily addicted to cell phones. It may be because they start cell phone use earlier than students from rural areas, and cell phones have become an inseparable part of daily life.[34,35]

Cell phone apps and activities are also found to be the influencing factors to addiction, which is consistent to the previous findings that the activities and contents provided by phone can lead to problematic cell phone use.[18,36] Chat apps and reading apps are risk factors for cell phone addiction among medical students. The chat apps tycoons, like WeChat, are consistently merging more and more social and living functions, which is cultivating and structuring students' way of communication and social contact, making themselves an inseparable part of life. To be on alert, the omnipotent chat app WeChat has been playing roles in education for several years: both faculty and students use it to check class attendance, take queries, and even give out formal notifications, which force students to stick to the apps to avoid neglecting important information. Universities and apps designers should pay attention to this growing phenomenon and take effective measures to separate the entertainment and notification functions in chat apps to prevent addiction.

Reading apps in China are not for educational purposes, but for novel and story reading.[37] In China, online literature in reading apps is different from formal books. They are superficial, imaginary, romance stories, bring pleasure and immerse but no knowledge.[38,39] Our research has found that nearly half of the students read online novels, but this kind of addictive and time-wasting readings should be avoided by medical students.[40] Instead, we found that education and learning apps rank 9th among all 15 types of apps and they do not cause any cell phone addiction at all. It indicates that cell phones are basically used for entertainment purposes rather than for learning or education purposes among medical students. Measures should be taken to guide students use cell phones to help the serious learning.[41]

As to the intervention plans, behavioral models should be borrowed to design an effective plan. We construct a health education initiative for cell phone addiction prevention and intervention among medical students based on the theoretical model of knowing, believing and acting. In terms of knowledge, health promotion and education on cell phone addiction should be given to improve medical students' knowledge and recognition of cell phone addiction. Brochures, posters, and lectures are all good ways of education.[42] In terms of belief, the danger and harm of cell phone addiction should be shown to students to help them strengthen the belief of avoiding cell phone addiction.[43] Cell phone addiction self-test questionnaires should be introduced to medical students, and medical students should be encouraged to conduct regular self-testing as a warning. In terms of behavior, based on the risk factors found in this survey, specific interventions should be designed to fit the characteristics of different sub-groups.[44] It might also be a good way to encourage students to avoid using cell phone in classrooms, libraries, and other study areas, so as to create a good support environment for less cell phone use and more devotion to study and research.

CONCLUSION

The prevalence of cell phone addiction is 16.2%. The students from urban areas, female students, students in love, and users of reading and chat communication apps face a higher risk

of cell phone addiction. Measures should be designed based on behavioral theories based on investigation findings to effectively prevent cell phone addiction among medical students.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

PATIENT CONSENT FOR PUBLICATION

Not required.

ETHICS APPROVAL

Not required

PROVENANCE AND PEER REVIEW

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