

Correlation between Smartphone Addiction, Sleep Quality and Physical Activity among Young Adults

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ABSTRACT

Introduction: In this era of smartphone revolution, the users are prone to get addicted to the convenience provided by it. The youth are the most vulnerable group for smartphone addiction. The smartphone revolution since 2000 is bringing noticeable changes in daily lives of people as it is providing more convenience in day to day life but along with that, there are many adverse-effects in interpersonal relationships, psychological well-being and physical health.

Aim: To measure smartphone addiction, assess sleep quality and assess physical activity among young adults and to establish the relationship among the three.

Materials and Methods: A cross-sectional study was conducted on 113 students recruited from a health science college in Mangaluru. Smartphone addiction was measured using Smartphone Addiction Proneness Scale-short version (SAPS)

which classifies the users as high risk, potential or dangerous risk and no risk users, sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI) and physical activity assessed using International Physical Activity Questionnaire-Short Form (IPAQ-SF). Karl Pearson's correlation coefficient test was used to find the correlation between the three.

Results: The correlation coefficient of smartphone addiction and sleep quality was 0.473 indicating a moderately significant positive correlation and that of smartphone addiction and physical activity was -0.335 indicating a negative significant moderate correlation.

Conclusion: From the present study it can be concluded that in high risk and dangerous or potential risk users of smartphones the quality of sleep and physical activity tends to decrease. Young adults showing insomnia symptoms should be attentively monitored for smartphone addiction.

Keywords: Exercise, Smartphone use, Youth

INTRODUCTION

A digital revolution was started in the 1990s by the introduction of Personal Computers (PC) and rapidly progressed to independent use of tablet PCs and smartphones [1]. The term smartphone was introduced in 1997 and has been ranked as a new class of mobile technology providing a number of facilities including voice and wireless communication and personal information management applications. The newer versions of the smartphones provide a greater access to the outside world through web browsing, Wi-Fi, third party applications etc; are more portable and hence attractive especially to the youth [2].

India stands in second position i.e., just behind China in wireless communication subscription worldwide. In September 2018, number of active wireless subscriptions in India was 1,013.23 million and is projected to increase largely in the next few years [3].

The smartphone revolution since 2000 is bringing noticeable changes in daily lives of people as it is providing more convenience in day to day life but along with that many adverse-effects in interpersonal relationships, psychological wellbeing and physical health. Considering the youth in the present scenario, they are the first generation to have grown up with so much exposure to high-tech media and this makes them more susceptible to the adverse-effects of smartphones and social media than older adults [1]. Excessive behaviour in using technology tools such as smartphones, android applications or its entertainments can be termed as mobile phone addiction or internet addiction [4]. Mobile phone use can be classified as being of a 'dangerous' level when daily activities start being affected by it [5]. Smartphone usage can be considered as an antecedent of behavioural addiction and has been linked to side effects like lower academic performance, decreased real life social interaction and negative effects on relationships [5].

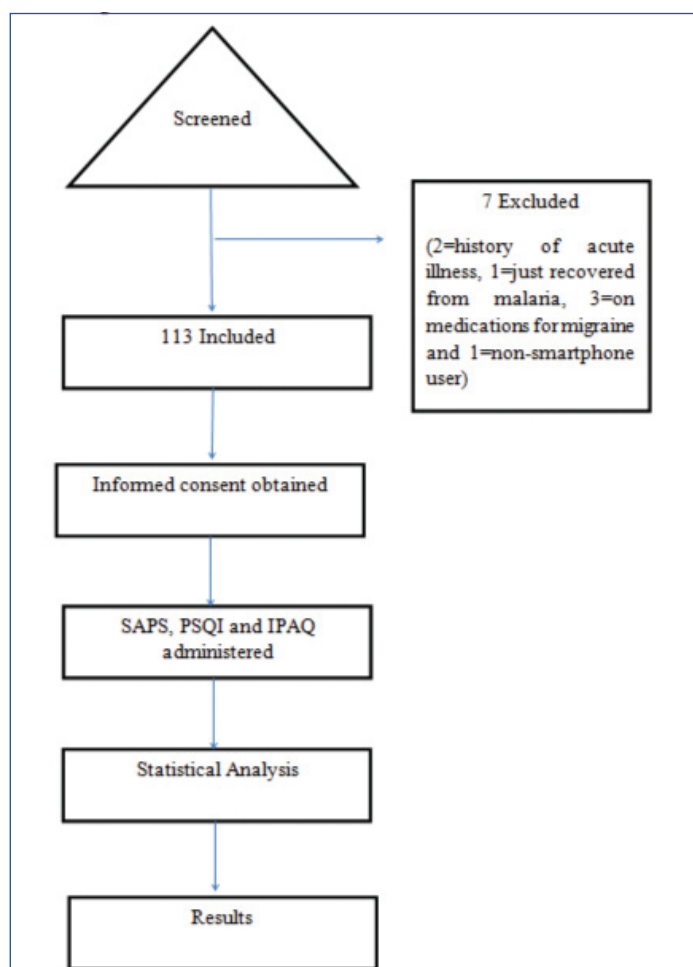
Previously, activities like internet browsing and updating social networking sites have been defined as sedentary behaviour. These sedentary or inactive behaviours can cause obesity and other metabolic disorders as it can lead to reduction in energy expenditure. These behaviours can also be associated with lower physical activity levels, in that they cause reduction or cessation of activities like outdoor games, walking and other forms of exercise [6]. Reduced cardiorespiratory fitness occurs as a result of sedentary behaviour. Spending more time using smartphones can also affect sleep. Proper sleep length and sleep quality is important for good emotional and physical well-being. Disruption of sleep including decreased sleep duration, sleep disturbances and daytime dysfunctions can even lead to low academic performance. Health can be directly influenced by sleep quality and duration. In 2000, Dement WC et al., reported that sleep is an active time in which many complex physiological, neurological and hormonal changes can occur. Chronic sleep deprivation also reduces the immune response of the body [7].

The relationship between smartphone use and physical activity, which includes walking, vigorous activities like aerobics and moderate activities like leisure time cycling, is obscure and controversial to some extent [8]. Many existing studies which were done on the association between use of electronic media and sleep were mainly focused on adolescents [9-11]. There were fewer studies which have investigated the relationship between smartphone addiction and sleep quality in young adults. As the youth have less parent-imposed constraints when compared to adolescents, they are more prone to overuse of smartphone or electronic media devices [5]. Studies relating to smartphone use and its relationship with components of well-being such as physical activity and sleep quality especially in the youth have not yet yielded conclusive results. Understanding this relationship further will help provide an insight into the extent

to which smartphone use is affecting the youth. Thus, a need was identified to find if smartphone use, sleep quality and physical activity levels were related to each other. The present authors hypothesised that an increased level of smartphone use may be associated with decreased sleep quality and decreased physical activity levels. The aim of this study was to find out the correlation between smartphone addiction, sleep quality and physical activity in young college going adults.

MATERIALS AND METHODS

This cross-sectional study was conducted in a health science college within city limits of Mangaluru, Dakshina Kannada, Karnataka, India in a period of two months, April and May 2019. A total of 113 students were enrolled for the study by convenience sampling. Ethical clearance for the study was obtained from the Institutional Ethical Committee (IEC no: AJEC/REV/64/2019). One week prior to the study, the students were verbally informed about the study to be conducted. A total of 120 students were screened for the study from which seven were excluded as two of them had a history of acute illness- fever, one had recently recovered from malaria, three were on medications for migraine and one was a non-smartphone user [Table/Fig-1]. Both men and women of age 19-25 who were using smartphones were included. A brief explanation about the procedure was given to all the participants following which a written informed consent was obtained from each of them. Each participant was given the questionnaires to fill up, with the examiner providing assistance as needed.



[Table/Fig-1]: Flow chart of progress of participants through the study.

Outcome Measures

Reliable and valid questionnaires were used as outcome measures.

- **Smartphone Addiction Proneness Scale:** This tool is a 4-point Likert's scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree) that contains 15 items and is

used to measure smartphone addiction. It contains four subdomains- disturbance of adaptive functions, virtual life orientation, withdrawal and tolerance. The level of smartphone addiction was categorised as high-risk (score ≥ 44), potential or dangerous risk (score 40-43) and no- risk (score ≤ 39) based on the scores. A higher score indicates higher degree of addiction [Annexure 1] [1,12].

- **PSQI:** The PSQI is a self-reported questionnaire which measures sleep disturbances and quality over an interval of one month. It contains 19 self-rated questions which are divided into seven components like subjective sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disturbances, use of sleep medications and daytime dysfunctions each weighted on a 0-3 scale. Global PSQI score within the range 0-21 is obtained by adding all the seven component scores. Scores which are higher than 5 indicate worse sleep quality and less than or equal to 5 indicates good sleep quality [Annexure 2] [13].
- **IPAQ-SF:** It is a 7 item self-rated scale which, based on the Metabolic Equivalent (MET) measures the frequency and duration of vigorous physical activities, moderate physical activities, walking and sedentary behaviour. A minimum of 1500 MET minutes a week are categorised as high, 600 MET minutes a week as moderate and if the subject is not meeting any of these criteria, then he/she is categorised as having low physical activity [Annexure 3] [8,14].

STATISTICAL ANALYSIS

The collected data were summarised using descriptive statistics, and the Karl Pearson's correlation coefficient was calculated to find the correlation between the variables. All the data analysis was performed using SPSS 16.0 for Windows.

RESULTS

A total of 113 young adults, 63 men and 50 women were included in the study. The descriptive statistics of age, SAPS, PSQI and IPAQ scores are given in [Table/Fig-2].

Variables	Mean	Std. Deviation
Age	22.15	1.69
SAPS	36.27	10.95
PSQI	5.95	2.62
IPAQ	1288.15	1591.01

[Table/Fig-2]: The mean age and mean scores of SAPS, PSQI and IPAQ.

*PA: Physical activity

Majority of users (50%) had low physical activity, around (63%) had poor sleep quality while only 24.1% were at potential risk for smartphone addiction. The distribution of users in each category of IPAQ, SAPS and PSQI are shown in [Table/Fig-3].

IPAQ	%	SAPS	%	PSQI	%
Low PA*	50.0	High risk	31.5	Good	37.0
Moderate PA	36	Potential risk	24.1	Poor	63.0
High PA	14	Normal users	44.4		

[Table/Fig-3]: Percentage distribution of participants under each category of IPAQ, SAPS and PSQI.

[Table/Fig-4] It shows a moderately significant positive correlation between SAPS and PSQI scores and moderately significant negative correlation between SAPS and IPAQ scores.

DISCUSSION

The present study was done with the objective of correlating smartphone addiction, sleep quality and physical activity among young adults. The rapid increase in the use of smartphones which has happened in recent years has made its users prone to

	PSQI	IPAQ
SAPS pearson correlation	0.473**	-0.335**
Sig. (two-tailed)	0.001	0.001
N	113	113
PSQI pearson correlation		-0.189*
Sig. (two-tailed)		0.050

[Table/Fig-4]: Correlation between SAPS, PSQI and IPAQ.
**Correlation is significant at the 0.01 level (two-tailed); *Correlation is significant at the 0.05 level (two-tailed)

smartphone addiction, which represents the merging of existing mobile phone and internet addiction problems into smartphone addiction. Various physical and psychological health problems like blurred vision, pain in the wrist or neck, anxiety, depression etc., are caused due to overuse of a smartphone [5]. The relationship between mobile phones, smartphones and the internet on one hand, and anxiety, depression, and sleep disturbances on the other in adolescents have been evaluated in some studies [15,16].

The present study showed a moderately positive significant correlation between smartphone addiction and sleep quality. An association between internet addiction and impaired sleep was found by Canan F et al., [9]. In terms of sleep duration, both internet use and the purpose of internet use are important. For example, using internet for social networking or watching online movies or videos at night are seen to lesser sleep durations [17]. Use of electronic media such as computers and smartphones at night are known to lead to depressive symptoms and disturbance of sleep. People with smartphones tend to sleep later with individual variations, but their sleep quality, i.e., the depth and restfulness of the sleep were not disturbed, according to a study done by Lemola S et al., [16]. Level of physical activity and risk of problematic internet use were seen to be inversely related to each other in a study conducted by Park S [18]. Excessive internet use or smartphone use especially during late hours of night can have indirect negative effects through sleep deprivation [13,19].

Sleep construction may be affected inversely by problematic internet use in that it may reduce slow-wave sleep, Rapid Eye Movement (REM) sleep, and sleep efficiency. The onset of sleep has been postulated to be delayed by the bright light of the computer screen by improving melatonin secretion [5,20]. There are some possible mechanisms concerning the relationship between electronic media use and poor sleep. Firstly, electronic media use may displace sleep; second, using electronic media devices may be associated with cognitive, emotional or physiological arousal; then, light emission of the screen of devices may affect sleep; and also mobile phone use in the bedroom may disturb sleep in that received messages may awake adolescents or youth at night [21].

Mobile phones emit electromagnetic fields which can have adverse-effects on sleep electroencephalograms. This electromagnetic field exposure also affects physiological factors such as sleep quality and the melatonin rhythm i.e., by affecting melatonin onset time. This probably happens by influencing the brain activity-particularly that of the pineal gland; it may also result in altered cerebral blood flow and brain electrical activity. Moreover, prolonged use of media can cause physical discomfort, such as muscle pain and headaches because of abnormal postures adapted during its use, which can negatively affect sleep [5,22].

In the present study, only a negligible negative correlation between sleep quality and physical activity and a negative moderate significant correlation between smartphone addiction and physical activity were found. This result is in line with the results of Park S, who found a direct association between physical activity and higher sleep satisfaction and inverse association between problematic internet use and physical activity among adolescents [18]. Smartphone addicts

have less real life interaction with people outside and they may have reduced physical activity leading to obesity. This can consequently be harmful to physical health by resulting in higher fat mass and decreasing muscle mass induced by less physical activity [12]. This implicates the importance of physical activity and the detrimental effects of smartphone addiction on it. A study on prevalence of overweight and obesity among adolescent users of information and communication technology of age 14, 16 and 18 has found a significant association between the two [6]. Proper education and warning should be given to the smartphone users regarding the adverse health effects caused by over use of smartphones. To increase physical activity and health it is important to reduce sedentary behaviours including smartphone use, computer use and television viewing to less than two hours per day [23].

LIMITATION

These limitations of the present study should be considered. Firstly, self-rated subjective measures were used to assess physical activity and sleep quality. Secondly, the present authors could not establish a causal relationship between the variables because this is a cross-sectional study. Also, the correlation was not done separately in men and women participants. Lastly, all of the participants were health science college students, and may not represent the total population.

CONCLUSION

In high risk and dangerous users of smartphones, the quality of sleep and physical activity tends to decrease. Young adults showing insomnia symptoms should be attentively monitored for smartphone addiction.

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ANNEXURE-1

Subdomain	Items
Disturbance of Adaptive Functions	My school grades dropped due to excessive smartphone use.
	I have a hard time doing what I have planned (study, do homework, or go to afterschool classes) due to using smartphone.
	People frequently comment on my excessive smartphone use.
	Family or friends complain that I use my smartphone too much.
	My smartphone does not distract me from my studies.
Virtual Life Orientation	Using a smartphone is more enjoyable than spending time with family or friends.
	When I cannot use a smartphone, I feel like I have lost the entire world.
Withdrawal	It would be painful if I am not allowed to use a smartphone.
	I get restless and nervous when I am without a smartphone.
	I am not anxious even when I am without a smartphone.
	I panic when I cannot use my smartphone.
Tolerance	I try cutting my smartphone usage time, but I fail.
	I can control my smartphone usage time.
	Even when I think I should stop, I continue to use my smartphone too much.
	Spending a lot of time on my smartphone has become a habit.

ANNEXURE-2

PITTSBURGH SLEEP QUALITY INDEX (PSQI)

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

- During the past month, when have you usually gone to bed at night?
USUAL BED TIME _____
- During the past month, how long (in minutes) has it usually take you to fall asleep each night?
NUMBER OF MINUTES _____
- During the past month, when have you usually gotten up in the morning?
USUAL GETTING UP TIME _____
- During the past month, how many hours of actual sleep did you get at night? (This may be different than number of hours you spend in bed.)
HOURS OF SLEEP PER NIGHT _____

INSTRUCTIONS: For each of the remaining questions, check the one best response. Please answer all questions.

- During the past month, how often have you had trouble sleeping because you...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) ...cannot get to sleep within 30 minutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(b) ...wake up in the middle of the night or early morning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(c) ...have to get up to use the bathroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(d) ...cannot breathe comfortably	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(e) ...cough or snore loudly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(f) ...feel too cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(g) ...feel too hot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(h) ...had bad dreams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(i) ...have pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(j) Other reason(s), please describe _____				

How often during the past month have you had trouble sleeping because of this?

- During the past month, how would you rate your sleep quality overall?

	Very good	Fairly good	Fairly bad	very bad
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

	No bed partner or roommate	Partner/ roommate in other room	Partner in same room, but not same bed	Partner in same bed
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

- | | Not during the past month | Less than once a week | Once or twice a week | Three or more times a week |
|---|---------------------------|--------------------------|--------------------------|----------------------------|
| (a) ...loud snoring | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) ...long pauses between breaths while asleep | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) ...legs twitching or jerking while you sleep | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) ...episodes of disorientation or confusion during sleep | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| (e) Other restlessness while you sleep; please describe _____ | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

ANNEXURE-3

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

- During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
____ days per week
 No vigorous physical activities ➡ **Skip to question 3**
- How much time did you usually spend doing **vigorous** physical activities on one of those days?
____ hours per day
____ minutes per day
 Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

- During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
____ days per week
 No moderate physical activities ➡ **Skip to question 5**

- How much time did you usually spend doing **moderate** physical activities on one of those days?
____ hours per day
____ minutes per day
 Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

- During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?
____ days per week
 No walking ➡ **Skip to question 7**
- How much time did you usually spend **walking** on one of those days?
____ hours per day
____ minutes per day
 Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

- During the **last 7 days**, how much time did you spend **sitting** on a **week day**?
____ hours per day
____ minutes per day
 Don't know/Not sure

This is the end of the questionnaire, thank you for participating.