“DOES EXCESSIVE INTERNET USAGE DISRUPT CIRCADIAN RHYTHM? – SPOTLIGHT ON A LOOMING BEHAVIOURAL ADDICTION AMONG MEDICAL STUDENTS”

Medical Science

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ABSTRACT

Background: In recent years the internet had become the most indispensable tool for students for learning, entertainment, and communication. Internet over-usage had emerged as a major problem among students causing the emergence of a problem that is defined as internet addiction (IA) which affects sleep and leads to several mental health problems. This study is the step toward understanding the effect of internet addiction on sleep quality among medical college students in Pondicherry.

Methods: This was a cross-sectional study. It is a questionnaire-based study administrated among 298 consenting medical students. The participants were assessed by proforma containing demographic details, variables related to internet use, questionnaires of Internet Addiction Test, and Pittsburgh Sleep Quality Index for Sleep quality. Statistical data were analysed by SPSS-25.

Results: A total of 287 students participated; 113 (39.4%) were males and 174 (60.6%) are females. Out of which Average users were 244 (85.01%) and problematic internet usage was 43 (14.99%), whereas poor sleep quality is found in 132 (45.99%) individuals. A significant correlation was found between internet addiction and the quality of sleep.

Conclusions: Participants with problematic internet users were more likely to have a poor quality of sleep and vice versa.

KEYWORDS

Internet addiction, problematic internet use, quality of sleep, circadian rhythm, medical students.

INTRODUCTION

Internet is the most important tool that had been developed in the early 1960s by the establishment of the first host-to-host network connection, that was created by the Advanced Research Projects Agency of the U.S. Department of Defense.¹ From then, in the past 30 years, there been a dramatic change in all fields. It has widely enabled the flow of information through the internet. The flow of information including entertainment, news, financial and academic material. It also brought people closer together by enabling various forms of interpersonal communication, notably E-mail, instant messaging, video conferencing and social networking.²

As per the report by the Internet and Mobile Association of India and curated by Nielsen, based on IRS data, the country has 504 million active internet users on November 2019, initially, there were 5 million internet users in 2000.³

The term internet addiction was first proposed by Dr. Ivan-Goldberg in 1995 for pathological compulsive internet usage.⁴ The first proposal for diagnostic criteria for Internet Addiction (IA) was advanced in 1996 by Dr. Young, by modifying the DSM-IV criteria for pathological gambling.⁵ Since then both name and criteria have been put forward to capture the problem, which is now most popularly known as Internet Addiction Disorder (IAD) or Problematic Internet Use (PIU).⁶

The IAD is a compulsive-impulsive spectrum disorder consists of at least three subtypes: excessive gaming, sexual preoccupations, and e-mail/text messaging. All of them share the following four components:

1. **Excessive use-** often associated with a loss of sense of time or a neglect of basic drives
2. **Withdrawal-** including feelings of anger, tension, and/or depression when the computer is inaccessible,
3. **Tolerance-** including the need for better computer equipment, more software, or more hours of use, and
4. **Negative repercussions-** including arguments, lying, poor achievement, social isolation, and fatigue.⁷

According to a study by Griffith, it is a subset of behavioural addiction and it meets 6 core components of addiction salience, mood modification, tolerance, withdrawal, conflict, and relapse.⁸ IAD could lead to poor-concentration and academic-performance, headache, musculoskeletal pain, and fatigue⁹ also many individuals have psychiatric co-morbidities, such as mood and anxiety disorders, dysfunctional personality, attention-deficit hyperactivity disorder, impulsivity, and high levels of aggressiveness.¹⁰⁻¹²

The American Psychiatric Association had included Internet Gaming Disorder in the updated version of DSM-5. IA has yet not been officially considered as a disorder. “Over the past year, there has been much debate concerning the inclusion of gaming disorder (GD) in the draft of the 11th revision of the International Classification of Diseases (ICD-11) by the World Health Organization (WHO).”¹³

Longer smartphone screen time has been associated with shorter sleep duration and poor sleep efficiency.¹⁴ Internet overuse has been associated with disturbances in sleep, daytime activity, and performance among students, which encompass the domains of biorhythms.¹⁵ Prolonged use of gadgets at night which emits blue and red light had an impact on serum melatonin, cortisol, alpha-amylase level causing a disturbance in circadian rhythm.¹⁶ The college students are the populations who are highly exposed to the internet for their studies, entertainment, gaming, and social media, these populations have a higher risk of IA which leads to various physical and mental problems in early adolescent periods.

This study aimed to study the prevalence of IA, to study the relationships between IA and quality of sleep among the medical students in Puducherry.

METHODS

The participants comprised medical students currently pursuing MBBS and Postgraduate at a tertiary care hospital in Puducherry. Institutional ethics committee approval was obtained for conducting the study. The study period was from March 2020-June 2020.

INCLUSION CRITERIA

Students who are pursuing medical education whose age is above 16 and below 40 years with no history of any other addictions, those who gave consent and adequate, reliable information were included in the study.

EXCLUSION CRITERIA

Participants who refuse to give consent did not give complete data and participants with current & past H/O psychiatric illness were excluded from the study.

Instruments

1. Semi-Structured-proforma

Details of demographics (name, age, gender), Year of study, modes of internet access, the purpose of using the internet (by choosing among the options like Searching information, entertainment, news, gaming or social networking etc.), money spent per year on the internet, and the average duration of use per day.

2. Internet Addiction Test (IAT; Young, 1998)⁵

IAT is a 20-item-Likert scale ranging from 0 (i.e., not applicable) to 5 (i.e., always) that measures the severity of self-reported compulsive use of the internet. Total IA scores were calculated, with possible scores for the sum of 20 items ranging from 0-100. According to Young's criteria, total IAT scores < 49 represent average users with complete control of their internet use, scores 40-79 represent over-users with frequent problems caused by their internet use, and scores 80-100 represent IA with significant problems caused by their internet use.

3. Pittsburgh sleep quality index scale (PSQI)¹⁷

PSQI is a self-report instrument designed to evaluate sleep quality over the last month. It consists of 19-items to produce 7 aspects of sleep quality (sleep onset latency, sleep duration, efficiency, quality disturbances, medication, and daytime dysfunction). The sum of these 7 aspects (0-3) yields a global score of sleep quality (0-21); a high score is an indication of poor sleep quality. The cut-off score of >5 is an accurate cut-off score to distinguish between patients with insomnia (poor sleep quality) and those without insomnia (good sleep quality).

Table:1 Sociodemographic in groups with and without IA.

Sociodemographic variables	Total N=287	Non-Problematic Internet usage IAT score <50, N=244	Problematic internet usage IAT score ≥50, N=43	p- value
Age	21.97 ± 2.49	21.96 ± 2.49	21.98 ± 2.49	0.973
Sex				0.484
Male	113 (39.4%)	94 (38.5%)	19 (44.2%)	
Female	174 (60.6%)	150 (61.5%)	24 (55.8%)	
Year of study				0.727
1 st year	18 (6.3%)	16 (6.6%)	2 (4.7%)	
2 nd year	55 (19.2%)	44 (18.0%)	11 (25.6%)	
3 rd year	45 (15.7%)	41 (16.8%)	4 (9.3%)	
4 th year	68 (23.7%)	57 (23.4%)	11 (25.6%)	
CRRI	77 (26.8%)	65 (26.6%)	12 (27.9%)	
Postgraduates	24 (8.4%)	21 (8.6%)	3 (7.0%)	
Modes of usage				0.465
Smartphone	284 (99.0%)	241 (98.8%)	43 (100%)	0.818
Computer	76 (26.5%)	64 (26.2%)	12 (27.9%)	0.010**
iPad or tab	63 (22.0%)	60 (24.6%)	3 (7.0%)	0.121
PlayStation	13 (4.5%)	13 (5.3%)	--	
Purpose of usage				0.298
Searching information	248 (86.4%)	213 (87.3%)	35 (81.4%)	0.062
Shopping online	136 (47.4%)	110 (45.1%)	26 (60.5%)	0.907
Watching movies	209 (72.8%)	178 (73.0%)	31 (72.1%)	0.004**
Online games	98 (34.1%)	75 (30.7%)	23 (53.5%)	0.140
Online music	178 (62.0%)	147 (60.2%)	31 (72.1%)	0.118
Online blog	28 (9.8%)	21 (8.6%)	7 (16.3%)	0.0001**
Online series/ TV	56 (19.5%)	38 (15.6%)	18 (41.9%)	0.981
Pornographic content	113 (39.4%)	96 (39.3%)	17 (39.5%)	0.003**
Online friendship	114 (39.7%)	88 (36.1%)	26 (60.5%)	0.023*
Chatting	222 (77.4%)	183 (75.0%)	39 (90.7%)	0.182
Social networking sites	188 (65.5%)	156 (63.9%)	32 (74.4%)	0.613
Online News	130 (45.3%)	109 (44.7%)	21 (48.8%)	
Amount spends for internet				0.074
5000 RS	262 (90.9%)	225 (92.2%)	36 (83.7%)	
5000RS	26 (9.1%)	19 (7.8%)	7 (16.3%)	
Time spent/day				0.338
4 Hours	247 (86.1%)	212 (86.9%)	35 (81.4%)	
4 Hours	40 (13.9%)	32 (13.1%)	8 (18.6%)	

Procedure

The purpose of the study was explained to all the participants, consent was obtained and the study questionnaire was administered by using google forms, direct contact and assessment were avoided due to prevailing COVID pandemic. Responses were obtained from 298 medical students out of which 287 students fulfilled the criteria were included in the study.

STATISTICAL ANALYSIS

Statistical analysis of the data was done by SPSS (IBM SPSS Statistics for Mac, Version 25.0, Armonk, NY:IBM Corp. Released 2017). Frequencies with percentages were calculated for categorical variables and mean and standard deviation will be calculated for continuous variables. The data will be compared using chi-square (x2) test for categorical variables and independent t-test for continuous variable. Pearson Correlation coefficient was done to find the linear relationship between continuous variables. Risk ratio were calculated for IAT and PSQI values. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographics of the study individuals

Out of 287 students, 174 (60.6%) were females and 113 (39.4%) were males. The mean age of the students was 21.9 ± 2.49 SD. Methods accessing internet is through smartphone (99.0%), computer (26.5%), Tab/iPad (22.0%) and PlayStation (4.5%).

Participants reported using the internet for searching information (86.4%), shopping online (47.4%), online news (45.3%), watching movies (72.8%), playing online games (34.1%), hearing online music (62.0%), online blog (9.8%), watching television (19.5%), watching pornographic content (39.4%), making online friends (38.7%), chatting (77.4%) and using social networking sites (65.5%). Around 167 (58.2%) were spending 1000-5000 Rupees on the internet, about 179 (62.4%) were spending about 1-4 hours on internet/day. To test our primary objective, we divided the overall sample based on IAT scores into two categories non-Problematic internet usage (includes those with IAT scores < 49), problematic internet usage (includes those with IAT scores 50–79 and 80–100). (Table:1)

*p-value of <0.05 statistically significant * p-value < 0.01 highly significant

Internet Addiction

Out of 287 individuals, based on Young's criteria, about 244 (85.01%) were non-problematic internet usage and 43 (14.99%) were problematic internet usage (14.99%). The mean IAT score was 32.68 ± 14.99 . The mean IAT score among female students was 32.33 ± 14.73 SD and male students were 33.20 ± 15.45 SD whereas male students have a slightly higher mean when compared to female students. (Table:2)

Table:2 The mean scores of the study participants in the IA Scale based on gender and usage pattern

Scale	Mean $\pm$ SD	Gender	
		Male	Female
IAT	32.68 ± 14.99	33.20 ± 15.45	32.33 ± 14.73
		Based on usage	
		Non-Problematic Internet usage	Problematic internet usage
		28.19 ± 11.17	58.12 ± 5.41

Pittsburgh sleep quality index scale

Out of 287 individuals, the mean PSQI Score is 5.32 ± 2.94 SD. Based on the PSQI scoring criteria the participants were divided into 2 groups i.e. PSQI < 5 Good sleep quality and PSQI > 5 poor sleep quality with a mean value of 3.17 ± 1.45 SD and 7.86 ± 2.09 SD respectively. PSQI scores based on the gender revealed higher mean scores among males when compared to females. (Table:3)

Table:3 The mean scores of the study participants in the PSQI Scale based on gender and usage pattern

Scale	Mean $\pm$ SD	Gender	
		Male	Female
PSQI	5.32 ± 2.94	5.44 ± 3.14	5.25 ± 2.80
		Based on Sleep quality	
		Good sleep quality	Poor sleep quality
		3.17 ± 1.45	7.86 ± 2.09

Sleep Quality in Participants with Different Degrees of Internet Addiction

PSQI scores on the different components of sleep in students with different degrees of internet addiction revealed higher mean scores on problematic internet usage when compared to non-problematic internet usage. With statistically significant lower scores in non-problematic internet users and compared those who are with problematic internet users on all components with the exception in sleep latency, sleep duration, use of sleep medication component. (Table:4)

Table:4 The Pittsburgh Sleep Quality Index (PSQI) scores on its different components in students with different degrees of internet addiction.

Components	Non-problematic Internet usage (Mean $\pm$ SD)	Problematic internet usage (Mean $\pm$ SD)	F value	p-value
Subjective sleep quality	0.88 ± 0.77	1.35 ± 0.92	5.55	0.0001**
Sleep latency	1.17 ± 0.94	1.35 ± 1.17	9.33	0.274
Sleep duration	1.19 ± 0.87	1.33 ± 0.86	0.04	0.356
Habitual sleep efficiency	0.05 ± 0.23	0.14 ± 0.41	17.55	0.031*
Sleep disturbance	0.99 ± 0.48	1.28 ± 0.63	17.57	0.001**
Use of sleep medication	0.09 ± 0.31	0.19 ± 0.63	11.62	0.106
Daytime dysfunction	0.67 ± 0.71	1.33 ± 1.02	16.73	0.0001**

Association between IAT and PSQI scores

Comparison of PSQI scores mean with normal internet usage and problematic usage shows significant difference which is statistically significant. (Table:5) Participants with poor quality of sleep were having high IAT scores with $p < 0.0001$. (Table:6)

Table:5 Association of IA with Sleep Quality.

Scale	Non-problematic Internet usage	Problematic internet usage	p-value
PSQI-Score	4.98 ± 2.73	6.95 ± 3.51	0.0001**

Table:6 Association of Sleep Quality with Internet use.

Scale	PSQI ≤ 5 good sleep quality, N=155	PSQI > 5 poor sleep quality, N=132	p-value
IAT-Score	27.90 ± 14.60	38.28 ± 13.48	0.0001**

Correlation between IAT and PSQI

Correlating the IAT score with the PSQI total score in Figure:1, there is a significant positive correlation between them ($r^2=0.441$, $p < 0.0001$). (Table:7) Correlation between IAT scores with sub component of PSQI scores (Subjective sleep quality, sleep latency, duration of sleep, habitual sleep efficacy, sleep disturbance, use of sleep medication, daytime dysfunction) shows significant positive correlation ($p < 0.01$ except use of sleep medication)

Table: 7 Correlation of IAT and PSQI total score & sub-dimensional score

PQSI	IAT (r- Pearson's correlation coefficient)	p-value
Total score	0.441	0.0001**
Subjective sleep quality	0.429	0.0001**
Sleep latency	0.232	0.0001**
Sleep duration	0.163	0.006**
Habitual sleep efficiency	0.208	0.0001**
Sleep disturbance	0.312	0.0001**
Use of sleep medication	0.149	0.012*
Daytime dysfunction	0.384	0.0001**

Figure:1 Correlation graph between Sleep Quality and Internet Use.

Odd's ratio for IAT and PSQI

Our study shows problematic internet usage will have 2.513 time more risk of poor sleep quality than non-problematic internet use with significant p value of 0.006. (Table: 8)

Table: 8 Odd's ratio for IA and Quality of sleep.

Variable	Non-problematic Internet usage N=244	Problematic internet usage N=43	Chi-Square	p-value	OR	95% CI
Quality of Sleep						
Good (N=155)	140	15	7.446	0.006*	2.513	1.277-4.943
Poor (N=132)	104	28				

DISCUSSION

Our study showed that 14.98% of all participants were considered problematic internet users. According to our study, there was a significant positive correlation found between IAT score and sleep quality (total score and subcomponent score) suggestive of poor quality of sleep in problematic internet users as compared to non-problematic group ($p < 0.001$). It is consistent with other study finding.¹⁸

The study showed that 45.99% of the participants had poor sleep quality and 54.01% of the students had a good quality of sleep.

Participants with poor quality of sleep were having high IAT scores in comparison to participants with good quality of sleep vice versa ($p < 0.001$), indicating that those who are having poor sleep quality tended to focus on internet activities, have strong anticipation of internet access, exhibit a lack of self-control over the amount of time spent on the internet, use the internet excessively and participated in social activities on the internet while neglecting real-world social life. The result was similar to the previous study showing a negative impact of excessive internet usage on sleep quality.¹⁹ Student using more hours of gadgets had a poor sleep quality ($p < 0.012$) these finding co-relates with the study conducted in Taiwan.²⁰

Our study showed that most students with higher IAT scores spend their time chatting, online friendships, online games, and watching online series. The student with poor quality of sleep spent their time in PlayStation, online music, social networking site, and online news these finding co-relates with the study conducted in Canada.²¹ Watching online series/Television ($p < 0.001$) is more addictive than other modalities of usage i.e. online friendships ($p < 0.003$), online games ($p < 0.004$), chatting ($p < 0.023$). Students who spent their time on social networking sites ($p < 0.002$) had more poor quality of sleep than other modalities i.e. PlayStation ($p < 0.013$), online music ($p < 0.023$), online news ($p < 0.034$). Factors contributing to the popularity of participation in social activities on the Internet among college students including the anonymous nature of the social media sites without requirement for showing one's own physical appearance, no limitations of space and time, and low risk offers an ideal way of alleviating loneliness and establishing social networks, thereby elevating the risks of excessive Internet use and Internet addiction thus reducing the quality of sleep.²²

Our results demonstrated significant associations of total IAT score with the total score of PSQI as well as the sub scores on its four items (except sleep latency, sleep duration, use of sleep medication) (Table 4). This finding is consistent with a previous study on the correlation between and sleep quality.²³ The results of the present study also implicated that an excessive use of Internet could be linked to impaired sleep quality, habitual sleep efficacy, sleep disturbances, and daytime dysfunction, further highlighting the adverse impact of Internet addiction on different parameters regarding sleep quality. The negative psychological and physiological impacts of impaired sleep quality have been well documented, including negative emotions,²⁴ anxiety,²⁵ obesity,²⁶ and increased risks of participating in hazardous behaviors (e.g., tobacco and/or alcohol consumption).²⁷ The stimulation of the central nervous system through participating in games and watching action movies online before sleep which are known contributors to prolonged sleep latency.²⁸

The item of sleep disturbance on PSQI is a measure of interferences during sleep such as the need for going to the toilet, troubled breathing, coughing, feeling hot or cold, having nightmares or pain. A high score on this item may imply a physical impairment or discomfort.²⁹

As previous studies show, that the negative influence of excessive internet use on normal physiological functions of the body including the manifestations of pain and physical discomfort may impair academic and/or work performance.³⁰ Furthermore, the results of this study demonstrated a link between Internet use and daytime dysfunction, suggesting a negative impact of Internet overuse on daily activities such as driving, eating regular meals, or participating in social activities during daytime hours this finding is consistent with other studies.¹⁹

Problematic internet was found to be 2.51 time more risk of poor sleep quality comparing with non-problematic usage (OR: 2.51, $p < 0.006$), which correlates with previous studies assessing sleep quality.³⁰ IA and other problematic internet use behaviors can have an important influence on the sleep-wake program, leading to sleeplessness and other sleep disorders.^{31,32} The emission of blue light through the screens that is known to suppress melatonin secretion from the pineal gland, leading to prolongation of sleep latency.³³ This indicates a growing need to increase awareness of healthy sleep habits to improve the quality of sleep of the students. Furthermore, strategies are required to moderate the use of internet

The strength of the study was the evaluation of IA among medical students, which is an upcoming behavioral addiction in the current

global scenario. The inclusion of the PSQI has enabled the evaluation of the subjective individual component of sleep.

The limitation of the study is the absence of a measure of daytime sleepiness scale which could have provided more insights into the dysfunction due to poor sleep. Assessment of the academic performance could have provided inputs regarding the varying effects of sleep on the functioning of medical students. The nature of work during internship encompassing night shifts and increased workload during COVID pandemic time could have played a confounding role in the assessment of sleep quality.

CONCLUSION AND IMPLICATIONS

Our findings showed that sleep quality is strongly correlated with the IA level. The results of this study demonstrated significant associations between problematic internet usage with most parameters of sleep quality (i.e., subjective sleep quality, habitual sleep efficacy, sleep disturbance, and daytime dysfunction), highlighting a poorer quality of sleep in those with problematic internet user than that of non-problematic internet users. Watching online series/television is more addictive and student who spent more time in social networking sites, have poor quality of sleep.

The study needs replication in a larger and more heterogeneous population. With the rapidly increasing internet use among medical students, IA is soon likely to emerge as a global health issue. Universal diagnostic guidelines for IAD need to be developed. Identifying and offering help to students with potential IA is important because this addiction often coexists with other psychological problems. Policymakers may think of public health policy including "Healthy and Responsible Internet Use" in curriculum and community awareness programs.

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