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Original Article

Physiology Section

Gender Variation in the Prevalence of Internet Addiction and Impact of Internet Addiction on Reaction Time and Heart Rate Variability in Medical College Students

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ABSTRACT

Introduction: In the present era, the internet is widely used by college students for academic, entertainment and communication purposes. College students are vulnerable to internet addiction due to various psychological and social factors. The prevalence and pattern of internet addiction vary between males and females. Internet addiction can significantly affect the physical and mental health of adolescents and college students resulting in poor academic performance and impaired functioning at work.

Aim: To assess the prevalence of internet addiction and its impact on the auditory and visual reaction times and short-term heart rate variability in medical college students.

Materials and Methods: In this cross-sectional study, 201 undergraduate medical students between 18 and 25 years of age participated. Young's 'Internet Addiction Test (IAT) questionnaire' was used to classify the subjects on the basis of their level of internet addiction and prevalence was calculated. In a smaller subset of 93 students who scored 50 or greater in the IAT questionnaire were taken as internet addicts. Auditory reaction time (Tone, Click), visual reaction time (Green, Red) measured using Audio-Visual Reaction Time Apparatus and short-term heart rate variability estimated using Polygraph was analysed between the internet addicts and non-addicts. Shapiro-Wilk normality test was used to assess type of data distribution and Mann-Whitney U-test used for comparison.

Results: Among 201 study subjects, 127 (63.2%) were males and 74 (36.8%) were females. Internet addiction was more prevalent in males (22.8%) than in females (8.1%). Auditory reaction time was significantly prolonged in the internet addicts compared to the non-addicts. Differences in the visual reaction time and short term-heart rate variability parameters were not statistically significant between the two groups with high and low IAT scores.

Conclusion: This study shows the prevalence of internet addiction as 17.4% in undergraduate medical students, based on Young's IAT score (50 or above). The internet addiction amongst males is significantly higher than in females. An understanding of the gender differences may be helpful for the clinicians to develop cognitive behavioural therapy, taking into account these findings. Auditory reaction time is prolonged, even in the early stages with a moderate level of internet addiction.

Keywords: Autonomic dysfunction, Mental health, Short-term heart rate variability

INTRODUCTION

Excessive uncontrolled internet usage (internet addiction) is increasingly being noticed among students nowadays, involving problematic computer usage that is time-consuming and which impairs the normal functioning in important domains of life [1]. Psychological and developmental characteristics of adolescents, easy accessibility and expectations make the college students more vulnerable to pathological Internet use [2]. Decrease in level of parental monitoring of young adults may also be a reason for this vulnerability. Gender difference is one of the frequently noted demographic dimensions which can influence the internet usage. Although data analysis from a review based on three major studies, namely Nomura Research Institute Cyber Life Observations Survey, Pew Biennial Media Consumption Survey, Current Population Survey from western population shows the gender gap in internet usage has disappeared over time, internet addiction is commonly reported in men [3,4]. The gender differences in internet usage can be due to the influence of psychological factors like social aggressiveness, expressiveness and the structure of friendship or due to the variation in areas of cognition between genders [5]. Internet addiction can lead to poor academic performance in school and college and impaired functioning at work [6]. It has been reported that there are structural abnormalities in the brain's grey matter among adolescents with IAD [7]. Unhealthy dietary habits, substance abuse, physical inactivity and sleep restriction have been noted in adolescents with Internet Addiction [6,8-10]. These factors are known to increase the risk for cardiovascular morbidity in internet addicts. Simple reaction time analysis (Auditory reaction time-ART and visual reaction time-VRT) is a part of mental chronometry analysis. It is an index of temporal sequencing and processing efficiency of cognitive operations by the brain [11]. Heart Rate Variability (HRV) is a simple non- invasive tool to assess cardiovascular risk [12]. Although there are good number of studies available from abroad, there are limited reports on the prevalence of internet addiction and its impact on cognition and cardiovascular risk among college students in India despite increasing levels of computer and Internet usage [2]. Hence the present study was designed to find the gender variation in the prevalence of internet addiction and to assess the impact of internet addiction on the reaction time (auditory and visual reaction times) and short-term heart rate variability in medical college students.

MATERIALS AND METHODS

This cross-sectional study was carried out in Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India, over a period of one year between February 2015 and January 2016, after obtaining approval from the Institute Ethics Committee (Ethics Committee No: JIP/IEC/SC/2014/10/710). The sample size calculation was done with the primary objective

to assess the prevalence of internet addiction in both male and female medical college students. Based on a previous study [13] with 11.8% of prevalence, 95% confidence interval and 20% drop-out, the sample size was decided as 200. Medical students studying MBBS (from second year to final year) in the age group of 18-25 years, using the internet for a period of at least one year or more and falling within the BMI range of 18-24.9 were included in the study. Those with a history of any chronic illness (diabetes, hypertension, endocrine disorders, mental illness/psycho-somatic disorders) and those on drugs that can affect their HRV, autonomic and CNS functions were excluded. A total of 201 volunteers gave informed consent to participate in the study. Level of internet addiction was assessed with the standard Kimberly Young-IAT questionnaire. Young's IAT, developed for screening and measuring levels of Internet addiction, is widely used and well-tested for its psychometric properties [14]. Young's IAT is a 20-item scale with scoring of 0-5 for each question [15]. Based on the scoring, subjects were classified as normal (<20), or mild (20-49), moderate (50-79) and severe (>79) internet addicts depending upon the degree to which their internet usage disrupts daily life. In this study, those who fell under the moderate and severe categories were grouped together as internet addicts (faced problems because of internet) and those who fell in the mild category were grouped along with normal users as non-addicts because they had control over their usage even though they surf the web too long at times.

Out of all volunteers, the auditory, visual reaction times and HRV data obtained in the morning hours from 93 participants were used for the comparison in order to avoid the effect of diurnal variation. Simple reaction time to auditory (Tone, Click) and visual stimuli (Green, Red) were estimated using an Audio-Visual Reaction Time Apparatus (designed by Anand Agencies, Pune) with the accuracy of 1 millisecond. Participants used their dominant hand for the test.

Lead-II ECG tracings were obtained with the sampling rate of 1000 Hz for five and half minutes using a polygraph (AD Instruments, Australia) after fifteen minutes of supine rest in a calm room with 24°C ambient temperature. It is followed by the screening for artefact correction and short-term heart rate variability analysis with Kubios-HRV software (Version 2.1, Biomedical Signal Analysis group, Department of Applied Physics, University of Kuopio, Finland) in the autonomic function testing lab, Department of Physiology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, as per the task force guidelines [12].

STATISTICAL ANALYSIS

GraphPad Instat (Version 3.06) was used for statistical analysis. Percentages were computed for finding prevalence. Chi-square test was used to compare the level of internet addiction between male and female participants. Shapiro-Wilk normality test was used to assess the type of data distribution. Mann-Whitney U test was used to compare the Reaction time and HRV parameters between the internet addicts and non-addicts. Values were recorded as median and percentiles. All analysis was performed with a significance level of 0.05.

RESULTS

Gender variation in the prevalence of internet addiction is given in the [Table/Fig-1]. Out of the total sample population of 201, 35 (17.4%) were internet addicts [Table/Fig-1]. The prevalence of internet addiction among males (29 out of 127 male students 22.8%) was significantly (p=0.013) higher than in females (6 out of 74 female students, 8.1%). The reaction time and HRV analysis were done in 93 participants. Among the 93 participants (72 male; 21 female), 17 volunteers (14 male; 3 female) had an IAT score of 50 or above. IAT score was calculated using Young's Internet Addiction Test questionnaire, in which the participants answered 20 questions by giving their grades between 0 to 5 for each question. Total score was estimated and classified into two groups in this study. IAT score of <50 were average online users (not-addicted) who were having control over their usage. Participants with IAT score of >50 (addicted) experience occasional or frequent problems due to the impact of internet usage.

Variables	Males	Females	Total sample
Addicted	29	6	35
Not addicted	98	68	166
Total	127	74	201

[Table/Fig-1]: Gender variation in prevalence of internet addiction.

The [Table/Fig-2] shows the comparison of auditory, visual reaction time and short term HRV between the non-addicted (n=76) and the addicted (n=17) internet user groups. Auditory reaction time was significantly prolonged for the addicted internet users (median-148.00 ms, 150.00 ms) compared to not-addicted internet users (median-133.50 ms, 137.50 ms) (Mann Whitney U=321.500, p=0.026; U=318.000, p=0.023) for the two types of auditory stimuli, tone and click respectively. Although the visual reaction time for green and red stimuli was slower in the addicted internet users, the difference was not statistically significant. Time and frequency-domain analysis of short-term heart rate variability were done. Differences in the HRV parameters (RMSSD, LF power, HF power, Total power and LF/HF ratio) between the two groups were not statistically significant.

Variables	Not addicted		Addicted		Significant
	Median	IQR	Median	IQR	
VRT (ms)					
Green light	155.5	143.25 - 167.75	157	146 - 182	0.92
Red light	151	140 - 164	162	144 - 173	0.15
ART (ms)					
Tone	133.5	126 - 143.75	148	127 - 156	0.026*
Click	137.5	129.25 - 146.75	150	137 - 172	0.023*
ST-HRV					
RMSSD (ms)	47.4	32.83 - 70.1	62.8	49.05 - 83.6	0.06
LF power (ms^2)	705	356.75 - 1170.25	828	509 - 1911	0.17
HF power (ms^2)	805.5	353 - 1934.25	1597	662 - 3661	0.063
Total power	2468.5	1425.5 - 4605.5	3600	2119.5 - 7736	0.058
LF/HF	0.812	0.457 - 1.36	0.615	0.32 - 1	0.239

[Table/Fig-2]: Comparison of auditory, visual reaction time and short term HRV between the 'not addicted' (n=76) and 'addicted' (n=17) internet user groups. ART: Auditory reaction time; VRT: Visual reaction time; ST-HRV: Short-term heart rate variability; LF: Low frequency; HF: High frequency bands of power spectrum; IQR: Inter-quartile range; RMSSD: Root-mean square differences of successive R-R intervals. Data were analysed using Mann-Whitney U-test. *p<0.05

DISCUSSION

Prevalence of internet addiction varies widely from study to study [16-19]. In the present study, the prevalence of internet addiction was 17.4%. This study ensures a heterogeneous representation as it was carried out in Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, where students are from various states and varied cultural backgrounds. The questionnaires were answered anonymously; this ensured that the participants could provide more factual and credible answers.

Male gender represented a highly significant association with Internet addiction, almost three times as much as females, in this study. Observations from East-Asian and European countries showed that Internet addiction is more prevalent among males [20,21]. Indian studies also report the male predominance on internet addiction [18,19,22,23]. It seems that male predominance on Internet addiction rate among adolescents and young adults is a globally constant observation even though internet usage appears to be equal in both genders. An understanding of the gender differences may be helpful for the clinicians to develop cognitive behavioural therapy, taking into account these findings.

Internet addiction is emerging as a significant negative outcome of internet use among young adults. Medical students due to boredom, lack of time to pursue hobbies and easy internet accessibility are vulnerable to internet addiction [24]. In this study, authors have also assessed the impact of internet addiction on auditory and visual reaction times and short-term heart rate variability among medical college students. Auditory reaction time is found to be significantly prolonged in internet addicts for both click (median- 150.00 ms, 148.00 ms) and tone (median- 137.50 ms, 133.50 ms) sound stimuli. Yuan K et al., have found reduced grey matter in the left rostral anterior cingulate cortex (rACC) and bilateral Dorso-Lateral Prefrontal Cortex (DLPFC) in internet addicts and it has significant correlation with the duration of internet addiction [7]. It is also noted that rACC is involved in normal hearing mechanism by error detection, conflict monitoring and noise cancellation [25] for appropriate cognitive response. Slow ART in the present study may be due to impaired cortical processing of the audio-signal and motor execution.

Though simple visual reaction time for Green, Red stimuli were prolonged in addicted internet users compared to non-addicted group, it was not statistically significant. Longer visual reaction time in patients with internet addiction disorders was similar to the findings reported by Dong G et al., [26]. It was also reported with reduced visual reaction time in video game players [27] and better visual and cognitive processes with prolonged engagement in a demanding visual task [28]. In the present study, with small population (n=17), subgroup analysis could not be done comparing the visual reaction time among various types of internet addicts like online game players, and those addicted to social networking.

Previous studies reported increased sympathetic activity and reduced parasympathetic activity in internet addiction disorders [29-31]. Altered sleep-wake schedule and insomnia were given as the bases of this sympatho-vagal imbalance in internet addicts [31]. In this study, there is no significant difference in the short-term heart rate variability between internet addicts and non-addicts. This may be due to the exclusion of participants with any sleep disorders and associated conditions which can be reflected in the autonomic function test. Moreover, all the participants in the present study were not severe internet addicts (IAT score was <79). Hence the HRV parameters were not affected significantly in this study group with the moderate level of internet addiction.

LIMITATION

The participants were asked to report details of past exposure and use of the internet, so there may have been some recall bias. All internet addicts in this study had IAT score of <79. Absence of severe internet addicts in the study sample could not help us to find the association between the level of internet addiction and the reaction times, heart rate variability. Though the female: male ratio was similar in addicted and not-addicted groups (approximately 1:3), it would have been better if analysis of reaction time and HRV might have been done in two genders separately. Subgroup analysis of internet addicts among various types of internet usage cannot be done with the small group (n=17) identified among the 93 participants.

CONCLUSION

Free Wi-Fi and internet services are provided by some medical colleges to students for academic purposes. However, unrestricted access to the internet may act as a double-edged sword and foster addiction. This study shows the prevalence of internet addiction as 17.4% in undergraduate medical students, based on Young's IAT score (50 or above). There is a significant gender variation in the prevalence of internet addiction, with the proportion of males addicted to the internet being nearly thrice as much as females. This understanding may be used to develop targeted treatment modalities.

Simple reaction time to external stimuli that assesses the mental chronometry and cognitive function are prolonged in internet addicts. Auditory reaction time is affected even in the early stages with a moderate level of internet addiction. Visual reaction time and heart rate variability were not significantly altered in the mild to moderate level of internet addiction.

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