Impact of internet addiction on heart rate variability in young adults

Jagadamba A, Shobha MV, Manogna S, Himavarshini

Sri Devaraj Ursacademy of higher education & research (SDUAHER), India

Correspondence Author: Jagadamba A,
E-Mail Id: jagadamba@sduaher.ac.in

Abstract:

For youth, the Internet presents a number of risks along with a multitude of opportunities. The primary implication of this study is to gain more information regarding HRV as it is an easy quick and Non-invasive technique used. As alteration in HRV is associated with a broad range of medical & psychological health problems, preliminary studies on the effectiveness of HRV assessing changes in related physiological parameters on internet addiction is warranted. The present study aims to study the effect of excessive internet usage with heart rate variability in young adults **Materials & Methods:** Cross sectional observational data was collected from 357 Professional students in the age group 18-25 years who are at least using internet for more than 6 months. Written Informed consent was obtained. Institutional ethical clearance was obtained .Demographic data & self-administered Young's scale of Internet Addiction scale was administered which was developed by Dr. Kimberly Young, for evaluating internet addiction. Then classified them into mild, moderate & severe internet adductors based on the score. A continous HRV recording for 5 minutes was performed in a quiet room by in-house built analogue ECG amplifier built by Dr Maruthy was used & raw data recording was done by Audacity software. Analysis of HRV data was done by KUBOIS HRV software. Linear parameters like Time domain, Frequency domain was analysed. Subjects who had been diagnosed with hypertension, diabetes, cardiovascular disease, or neurological diseases or who are consuming medications such as beta -blockers or sedatives, psychiatric drugs & also who are smokers ,alcoholic addicts , that might affect the autonomic nervous system will be excluded from the study.SPSS22 version was used to analyze the data. Descriptive statistics & One way ANOVA was used to test the difference in the mean between the different groups of internet addiction score. Tukey post hoc Test was used to find the significant difference in between the group. & $P<0.05$ will considered statistically significant. **Results:** One way ANOVA for the mean of internet Addiction score showed statistically significance different between groups $(F_{[2,354]} = 1474.745, P < 0.001$.One way ANOVA for the mean of duration of usage of internet showed statistically significance different between groups $(F_{[2,354]} = 327.16, P < 0.001$.Tukey's post hoc test showed that the mean of duration of severe internet addictors score is significantly higher compared to moderate & mild internet addictors which is statistically significant$(P<0.001)$.One way ANOVA for the LF/HF ratio showed statistically significance different between groups $(F_{[2,354]} = 11.934, P < 0.001$.Tukey's post hoc test showed that the mean of LF/HF of severe internet addictors score is significantly higher compared to moderate & mild internet addictors which is statistically significant$(P<0.001)$. The difference between mean of LF/HF mild and moderate internet addictors was not significant. **Conclusion:** In internet addictors the sympathetic activity is higher with lower parasympathetic activity which is statistically significant. As youngsters are becoming more prone for this excessive internet usage,it's an additional area requiring attention by the clinicians to provide appropriate interventions either in aspects of pharmacological or nonpharmacological.

Keywords: Internet addiction, Heart rate variability, Autonomic activity

Introduction:

Internet usage among the general population is increasing widely. According to Internet World stats, up to November 2015, there were around 3.36 billion users.[1] In India, it is estimated that 34.8% of the general population are active internet users in 2016 & most of them are young adults.[13] Excessive internet usage is otherwise termed as internet addiction, where they defined it as increased or less controlled preoccupations, urges, or behaviors regarding computer use & internet access that lead to internet impairment or distress. It has, however, been proposed to be included as a diagnostic entity in the Diagnostic &Statistical Manual of Mental Disorders, Fifth Edition (DSM V).[10] Unlike drug addiction, excessive internet usage does not directly act via substance consumption on receptors of neural substrates to induce compulsive and impulsive behavior. Though it has many uses like social interactions, information retrieval & entertainment, losing control over internet use might negatively impact our daily lives. Among internet users, young adults are widely using the Internet & getting addicted to the same. The stress of using the Internet by students is hidden & its excessive usage is not known.[2] Four components have been suggested as essential to the diagnosis, such as excessive internet use, often related to loss of sense of time—withdrawal, including feelings of anger, tension, or depression when the computer is inaccessible. Tolerance includes better computer equipment, more software, or more hours of use. Adverse consequences, including arguments, lying, poor school, social isolation & fatigue.[11]All which lead to autonomic imbalance

Young defined internet dependence as an impulse control disorder which does not involve intoxicants, and an individual loses control of internet use to cause significant relational, occupational, and social impairments.[3] In young adults, using the Internet early can produce both beneficial and adverse effects. It is a well-known fact that many young adults suffer from excessive internet usage, which is almost similar to narcomania or alcoholism.[4]

The effect of internet overexposure during young adulthood is of particular clinical and societal significance. younger age is a period of significant changes in neurobiology related to decision-making and thereby exhibits a higher susceptibility to affective disorders and addiction. The pathogenesis of excessive internet usage involves complicated and multiple psychopathological and behavioral symptoms.[5]

Heart rate variability (HRV) is the temporal variation in consecutive heartbeats measured from a standard electrocardiogram & the assessment of this difference is performed in the time domain, frequency domain & nonlinear analysis. These parameters are used to assess cardiac autonomic imbalance between sympathetic & parasympathetic mediators of the heart.[4] Decreased HRV means a sympathovagal imbalance with a tilt towards sympathetic predominance or a reduction in parasympathetic activity.

Diminished HRV is believed to reduce individuals' capacity to physiologically withstand and recover from environmental pressures. Via such processes, low HRV is considered to contribute to or exacerbate multitudinous poor physical and mental health outcomes. Knowledge of the interplay between physiological and psychological phenomena that as excessive internet usage and how this phenomenon might be manipulated to promote health have been persistent areas of growth in both medical and psychological fields of study Lu et al. reported that subjects at high risk of Internet addiction had stronger blood volume pulse and respiratory response and weaker peripheral temperature and skin conductance, suggesting changes in the autonomic nervous system response to Internet addiction.[8] A recent study done on internet addiction & HRV in school children has shown that Internet addiction is associated with increased sympathetic activity and lower parasympathetic activity.[9]

To enable a better understanding of excessive internet usage, it is essential to combine our knowledge of function of the autonomic nervous system, mainly by HRV.

However, limited studies have been done linking excessive internet usage to the autonomic nervous system in adults in India; the present study aims to study the effect of excessive internet usage on heart rate variability in young adults, a non-invasive simple physiological technique.

Objectives

- To determine internet addiction in young adults by using an internet addiction test questionnaire
- To determine HRV parameters in young adults.
- To compare HRV parameters among internet addiction users.
-

Materials& Methods

Design: Cross-sectional observational data was collected from Professional students ages 18-25 years who are at least using the Internet for more than six months. Written Informed consent was obtained. Institutional ethical clearance was obtained.

Sample size:

The sample size was estimated based on a previous study to compare two means of Low frequency(Hz) on internet addictors & nonaddictors,

By using the formula calculated by G power software, a sample size of 49 subjects per group is needed to detect a difference of ≥0.608(effect size) in mean LF (Hz) between the 2 (independent) groups with 80% power, using a two-sample t-test and assuming a (two-sided) α of 0.05, and an SD of 1.1 (Hz).

Interventions: none

The data will be collected by self-administering the questionnaire to the professional students, which consists of two parts. The first part was the collection of demographic information - age, sex, religion, education, type of phone used, and time spent on the Internet per day. The second part was Young's scale of Internet Addiction scale was administered which was developed by Dr. Kimberly Young in 1998 and is one of the most reliable scales for evaluating Internet addiction for around 350 professional students .3Then classified into mild (20 – 49 points); moderate (50-79)& severe internet addictors (80-100) based on the score obtained by the questionnaire. A simple systematic sampling was administered to collect the data. That is, out of the total sample of 350 was divided by the sample size obtained for our study(350/49=7) & in numbers 1-7, every third person who is addictor or nonaddictor was recruited for the study.

A continuous HRV recording for 5 minutes was performed in a quiet room. To obtain electrocardiographic signals, an in-house built analog ECG amplifier built by Dr. Maruthy was used & raw data recording was done by Audacity software. Analysis of HRV data was done by KUBOIS HRV software. Linear parameters like Time domain, Frequency domain were analyzed. Participants were advised to abstain from caffeinated food & beverages on the day of the recording.

Subjects who had been diagnosed with hypertension, diabetes, cardiovascular disease, or neurological diseases or who are consuming medications such as beta-blockers or sedatives, psychiatric drugs & also who are smokers and alcoholic addicts which may affect the autonomic nervous system were excluded from the study.
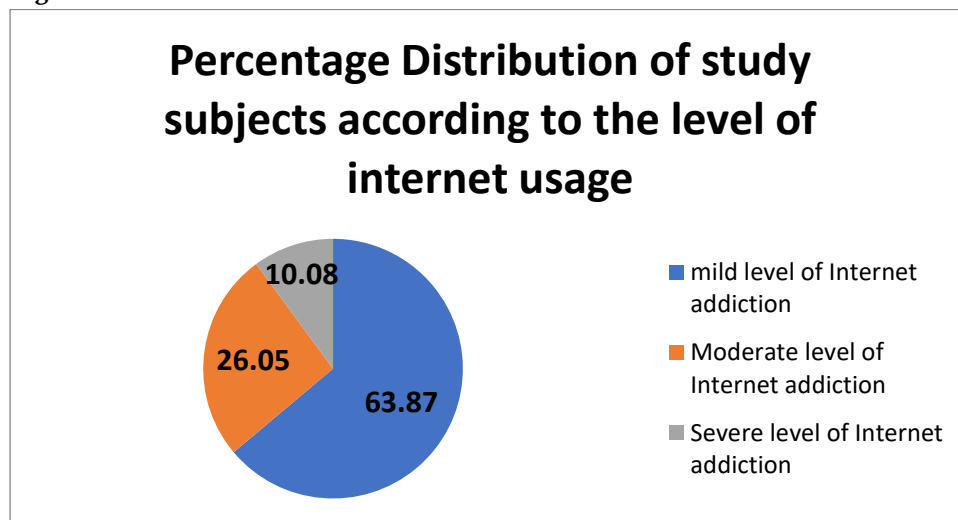
Analysis & Statistical Methods

SPSS 17 version will be used to analyze the data. Descriptive statistics & Pearson's correlation, independent t-test was done to analyze the quantitative data & Mann Whitney U test, and Chi-Square test was done to analyze the nonparametric data & $P<0.05$ was considered statistically significant.

Results:

Table-1: Comparing the HRV parameters among the mild ,moderate & severe internet addictors by one way ANOVA test

	n=228	n=93	n=36		
variables	mild(mean±sd)	moderate (mean±sd)	high(mean±sd)	F value (pdf;2,354))	p
Age(years)	21.47±2.302	21.53±2.306	21.72±2.313	0.183	0.833
duration(hours)	4.49±1.365	5.98±1.635	11.17±1.63	327.163	0.001
Internet addiction score	38.84±5.35	64.68±7.097	86.5±3.501	1474.745	0.001
Mean RR	561.59±260.25	553.8±277.84	544.04±294.69	0.08	0.923
(SDNN)	315.81±188.6	347.72±201.38	468.03±263.06	9.068	0.001
Mean HR	80.52±11.55	80.7±12.21	78.98±11.87	0.304	0.738
RMSSD	279.55±342.38	311.17±358.13	345.04±405.57	0.676	0.509
TINN	1314.4±1701.32	1480.53±1855.379	1492.86±1783.159	0.387	0.679
VLF (0-0.04 Hz)	568.48±624.621	553.15±267.066	575.25±228.086	0.036	0.965
LF (0.04-0.15 Hz)	623.84±287.49	555.35±247.37	573.75±228.007	2.292	0.103
HF (0.15-0.4 Hz)	991.54±502.79	771.44±284.397	587.58±248.319	18.354	0.001
SD1	210.82±256.37	229.16±263.357	264.63±303.306	0.71	0.492
SD2	311.61±400.21	346.97±418.73	373.96±456.73	0.505	0.604
SD2/SD1	1.57±0.71	1.62+0.69	1.35±0.53	2.13	0.12
Total power	1615.38±661.883	1326.8+511.295	1161.33±447.405	13.486	0.001
LF/HF	0.71±0.43	0.72±0.16	1.03±0.30	11.934	0.001

Figure-1:

Percentage Distribution of study subjects according to the level of internet usage

- mild level of Internet addiction — 63.87
- Moderate level of Internet addiction — 26.05
- Severe level of Internet addiction — 10.08

This study is a cross-sectional questionnaire-based study conducted among professional students from different faculties. Around 357 subjects with ages ranging from 18 to 25 years were included in this study. The mean age was 21.5+2.29 years which was an age-matched Table 1.

Out of the total subjects, 228 (63.87%) had mild levels of Internet addiction,93 (26.05%) were Moderate levels of Internet addiction & 36(10.08%) had Severe levels of Internet addiction [Figure 1].
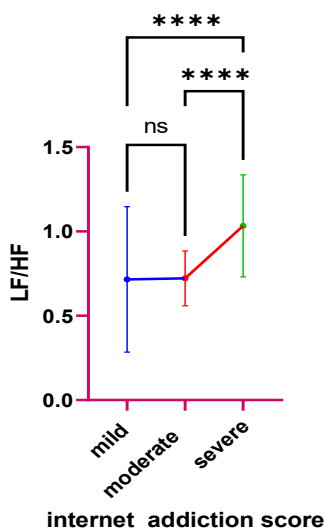
Figure-2

comparison of internet addiction score among young adults by One way ANOVA & POST -HOC Tukey test of significance
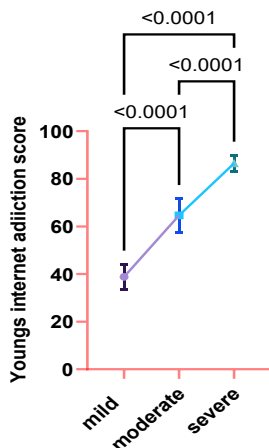
One-way ANOVA for the mean of internet Addiction score showed a statistically significant difference between groups (F [2,354] = 1474.745, P < 0.001. Tukey's post hoc test showed that the mean of internet addictors score is significantly higher compared to moderate & mild internet addictors (P<0.001).(Fig-2)One-way ANOVA for the mean of the duration of usage of the Internet showed a statistical significance difference between groups (F [2,354] = 327.16, P < 0.001. Tukey's post hoc test showed that the mean duration of severe internet addictors score is significantly higher compared to moderate & mild internet addictors, which is statistically significant(P<0.001).(FIGURE-2)

Figure-3

comparison of LF/HF ratio among the internet users by ONEWAY ANOVA & POSTHOC Bonferroni significance test

One-way ANOVA for the LF/HF ratio showed statistical significance differences between groups (F [2,354] = 11.934, P < 0.001. Tukey's post hoc test showed that the mean LF/HF of severe internet addictors score is significantly higher compared to moderate & mild internet addictors, which is statistically significant(P<0.001). The difference between the mean of LF/HF mild and moderate internet addictors was not significant.(FIGURE-3)

Figure-4

Comparison of High Frequency (0.15-0.4 Hz) by ONEWAY ANOVA among young adults & POSTHOC TUKEY TEST of significane
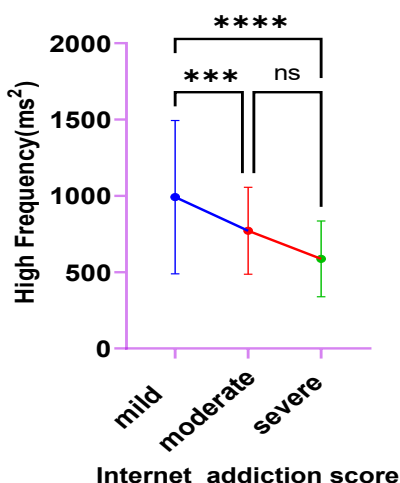
One-way ANOVA for the mean of high frequency showed statistical significance differences between groups (F [2,354] = 18.354, P < 0.001. Tukey's post hoc test showed that the mean of high frequency of severe internet addictors score is significantly lower compared to mild internet addictors, which is statistically significant(P<0.001). The difference between the mean of moderate & severe internet addictors was not significant.(FIGURE-4)

Figure-5:

Comparison of SDNN by One-way ANOVA & POSTHOC TUKEY test for significance
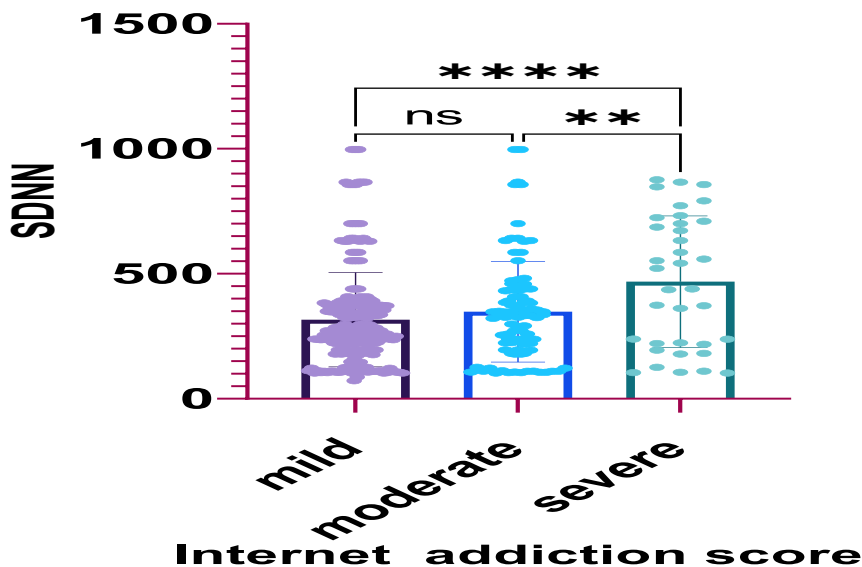
One-way ANOVA for the mean of SDNN showed statistical significance differences between groups (F [2,354] = 9.068, P < 0.001. Tukey's post hoc test showed that the mean SDNN of severe internet addictors score is significantly higher compared to mild internet addictors & moderate addictors, which is statistically significant(P<0.001). The difference between the mean of moderate & mild internet addictors was not significant.(FIGURE-5)

Discussion:

Internet overuse continues to increase due to less cost, easy accessibility, and increasing sophistication of internet-related devices.When the present study was planned, some aspects of previous internet addiction were considered to be particularly important. Given the relative newness of internet addiction, little is understood about the habit-forming nature of the Internet & its potential abuse in young adults. As the Internet is in our lives at home, school & work can create marital, academic & job-related problems.

A close look at the subjective experience during internet use in young adults would be helpful for distinguishing between pathological cases from just problematic ones.in the present study 10.08% of them are severely addicted to internet.(FiG-1).As with heavy Internet usage, the respondents experienced low mood, restlessness, irritability, and anxiety when they stayed for a long time on the Internet. In the present study the duration of usage of internet among severely internet addictors is significantly higher compared to the other groups. The attempt to prevent stress and problems by using the Internet is also one of the psychological problems evaluated.[6]

In the present study the HRV parameters are altered, where SDNN,LH/HF ratio is significantly high in severely internet addictors compared to the other groups.A study by Phil Reed et al. showed a relationship between problematic internet use and reduced immune function. The negative relationship between the immune function & problematic internet use may be mediated by levels of increased stress due to increased sympathetic nervous activity, which is related to immune suppressants.[12]

There are media reports that unlicensed training camps are used to wean children, often in their teens, from overuse of the Internet, which has resulted in the death of young individuals. This relative ignorance also extends to treatment. The few published treatment studies for Internet addiction are based on interventions and strategies used to treat substance use disorders.Thus, it is impossible to recommend any evidence-based treatment for Internet addiction. Internet addiction is a stressful life event to the onset of depression or anxiety, which is endogenous. It is likely that both the etiology & pathophysiology of internet addiction remain elusive due to highly complex interactions between psychological & physiological factors. Parasympathetic activity is usually a component of the relaxation response, which can be studied by HRV.

Conclusion:

In internet addictors, the sympathetic activity is higher with a lower parasympathetic activity which is statistically significant. As youngsters are becoming more prone to this excessive internet usage, it is an additional area requiring attention by clinicians to provide appropriate interventions, either in aspects of pharmacological or nonpharmacological.

References:

1. Internet users in the world: distribution by world regions – 2015, Q2. Internet World Stats: Usage and population statistics. Available from: URL: www.internetworldstats.com
2. Sharma A1, Sahu R, Kasar PK, Sharma R . Internet Addiction Among Professional Courses Students: A Study From Central India.International Journal of Medical Science and Public Health 2014 ;3: 1069-1073.
3. Young KS. Caught in the Net: How to recognize the signs of Internet addiction and a winning strategy for recovery. New York, NY: John Wiley & Sons, Inc; 1998. p. 196.
4. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation, and clinical use. Eur Heart J 1996;17:354-381.

5. Internet Addiction Neuroscientific Approaches and Therapeutical Interventions: Montag C, Reuter M, editors. Switzerland: Springer International Publishing; 2015. Available from: Ebook Library

6. Alam SS, Nik Hazrul Nik Hashim NM, Ahmad M, Wel CAC, Nor SM, Omar NA.Negative and positive impact of internet addiction on young adults: Empirical study in Malaysia.Intangible Capital 2014;10: 619-638.

7. Dong, Guangheng, Hu Y, Lin X. Reward/Punishment Sensitivities Among Internet Addicts: Implications for Their Addictive Behaviors. *Progress in Neuro-*Psychopharmacology *& Biological Psychiatry* 2013; 46:139–145.

8. Lu DW,Wang JW,Huang AC.Differentiation of Internet addiction risk level based on autonomic nervous responses: the Internet-addiction hypothesis of autonomic activity.Cyberpsychol Behav Soc Netw 2010;13:371-378.

9. Lin PC, Kuo SY, Lee PH, Sheen TH, Chen SR. Effects of Internet Addiction on Heart Rate Variability in School-Aged Children. Journal of Cardiovascular Nursing 2014;29:493-498.

10. Weinstein A, Lejoyeux M.Internet addiction or excessive internet use.The American Journal of Drug & alcohol abuse 2010;36:277-283.

11. Reed P, Vile R, Osborne LA, Romano M, Truzoli R. Problematic Internet Usage and Immune Function. PLoS ONE 2015; 10(8): e0134538.