Original Article

Does mild internet use augment cognitive functions?: Preliminary evidence

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Abstract

Background: Internet usage leads to psychological disturbances, social problems, and neuropsychological dysfunctions. Alhough there is no definite trend has been reported for the association of augmentation of cognitive function and internet use pattern. **Method:** The current work explored the neuropsychological profile among healthy, mild, and moderate users of internet in the age group of 18 to 30 years. Sixty subjects (20 healthy internet users, 20 mild internet users, and 20 moderate internet users) were screened for internet usage using internet addiction test. Background datasheet, NIMHANS comprehensive battery of neuropsychological tests, and Wechsler memory scale III (Indian adaptation) were administered in an individual setting. **Results:** It revealed that mild users have performed relatively better than healthy normal controls on mental speed, sustained attention, cognitive switch, and interference scores on Stroop test. **Conclusions:** It has implication for evolving psychological intervention for promotion of mild internet use for the promotion neuropsychological functioning as well as physicians at primary setting can educate users about benefits of mild use of the internet and other technology devices. It will help in the promotion of healthy use of technology.

Keywords: Cognitive function, internet, usage

Introduction

With the advancement of technologies, internet has revolutionized the way we communicate. With the growth of internet over the last two decades, its excessive use has been associated with negative consequences. The term internet addiction can be described as a dysfunctional behaviors characterized by excessive or poorly controlled preoccupations, urges or behaviors with regard to computer use, and internet access leading to impairment or distress. Internet addiction is defined as an "individual inability to control his or her use of the internet, which eventually causes psychological, social, school, and work difficulties in a person's life."[1,2]

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The causal factors for internet addiction includes (a) social factors like demographic factors, availability, and access to the internet; and (b) biological factors like genetic factors.[3-5] Another explanation for internet addiction according to neurobiological studies explained the dopamine release in nucleus accumbens (reward structure of the brain) is specifically involved in internet addiction[6,7] and psychological factors which includes personality characteristics like impulsivity.[8-11]

The excessive use of internet affects the sleep cycle and also cause back strain/eye strain and disturbance in interpersonal functioning.[12,13] Physical (i.e. eye strain)/psychological distress (decreased sleep, irritability, and restlessness) were present as morbidities among 6.8% mobile phone users, 4.2% internet user, and 3% social networking sites users. However, 3.3% of the sample wanted to change their internet activities and 4.2% wanted cut down expenses on the mobile phone.[14] The number of hours spent online were high among internet addicts. They

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tended to avoid interpersonal relationship with people that led to the development of psychological symptoms such as depression and anxiety.[15] It also led to a chronic psychiatric disorder such as depression, anxiety, and stress.[16]

Excessive use of internet led to deficits in performance on various neuropsychological tasks. These included decision-making deficits, reductions in prefrontal control and other executive functioning, and inability to inhibit responses to certain stimuli[17] Individuals with pathological internet use had dysfunction in response inhibition[18] However, the errors were higher in neuropsychological tests among internet addicts than the control group.[19] Individuals with internet addiction disorder experienced dysfunctions in working memory, executive function, and impulsivity in comparison to pathological gambling persons.[20] Among 15 internet addiction disorder (IAD) subjects and 15 healthy control subjects, individual with internet addict disorder showed impaired cognitive flexibilities.[21] Individuals with IAD and Attention Deficit Hyperactive Disorder (ADHD) in the age group of 16–18 years had an impaired inhibition and working memory functions specifically related to internet-related stimuli.[22] Neuroimaging studies among individuals with internet addiction also suggested findings similar to that observed among individuals with psychoactive substance use disorders.[17]

Among the available literature, the small sample size studies nationally and internationally had shown a relationship between the problematic internet use and its association with neuropsychological impairment specifically with related to decision-making, cognitive flexibility, and working memory. There is a dearth of literature on the comparison of neuropsychological variables among various forms of internet users. The present study assessed the neuropsychological variables among healthy internet users and users with mild and moderate nternet use.

Material and Methods

Aim

To assess the neuropsychological correlates of internet use.

Objective

- To assess the neuropsychological functions of internet users.

Sample

The sample consisted of 60 individuals in the age group of 16 to 30 years. It included 20 normal internet users, 20 mild internet users, and 20 moderate internet users. Internet Addiction Test (IAT) was used to screen their internet usage. Subjects who had access to internet usage for minimum of 1 year and could read and write English were included in the study. Subjects with neurological disorders, psychiatric disorders, and other medical problems, which could interfere in taking assessment were excluded from the study.

Sample site: Subjects were recruited primarily from Services for Healthy Use of Technology (SHUT) clinic and NIMHANS Centre of Well Being, Bengaluru. Colleges, and workplace-based in Bangalore were also approached for the study.

Tools

1. **Background data sheet:** was developed by the investigator to record socio-demographic details that covered age, sex, socio-economic status, education, occupation, religion, marital status, details of psychiatric illness, neurological disorders, substance use, and technology use.
2. **Internet Addiction Test:** It is used to identify the addictive use of internet among adolescents and young adults. Total scores that range from 0 to 30 points are considered a normal level of internet usage; scores of 31 to 49 indicate the presence of a mild level of internet addiction; scores of 50 to 79 reflect the presence of a moderate level; and scores of 80 to 100 indicate a severe dependence upon the internet. The author got the copyright for using the test.[13]

3. Cognitive tests

A. Tests of executive function

NIMHANS Neuropsychological Battery.[23]

Mental Speed: Digit symbol substitution test developed by Wechsler in 1981. The test consists of a sheet in which the numbers 1–9 are placed randomly in 4 rows in which the subject has to copy symbols corresponding to the digits as quickly as possible.

Response inhibition: Stroop color and word test developed by Golden 1978. The higher scores indicating better performance and less interference score on reading ability. The total time taken for the test is 5 min.

Cognitive flexibility: Color trails test 1 and 2 developed by D'Eliz, Satz, Uchiyama, and White in 1996. The total time taken for both the tests and the errors in test 2 form the scores.

Planning: Tower of London test was developed by Shallice in 1982. The scores are according to the meantime taken as well as the mean number of moves for each minimum number of moves, besides the total number of problems solved with a minimum number of moves.

B. Tests of memory

Wechsler Memory Scale III (WMS III, 1997), Indian Adaptation.[24]

Working memory

Digit span: The test consists of numbers which are presented in both forward and backward of progressively increasing digit sequence with two trials per item. The score obtained is the sum of the maximum digit sequence correctly recalled in each forward and backward condition.

Spatial span: It is a test of visual working memory in which the subject has to tap in either the same or reverse order in which the examiner has tapped a set of numbered cubes. **Procedure:** Subjects approaching SHUT clinic, inpatients, and outpatients from Psychiatry department of NIMHANS, college and workplace were approached for the study. Prior consent was obtained from the treating team, college principals and officials from the workplace. Their informed consent was sought from the individuals and also from college and workplace authorities. Confidentiality of the obtained information was assured. The socio-demographic details were filled by the individuals. Sixty subjects were screened for the study according to the IAT, NIMHANS Neuropsychological battery that was digit symbol substitution, Stroop test, color trail test, tower of London, and tests from Wechsler Memory Scale III (digit span and spatial span) were administered in an individual setting.

Statistical analysis

Descriptive statistics such as mean, standard deviation percentage, and frequencies were used to analyze the demographic details. Pearson's product-moment correlation was computed to examine the relationship between the variables. ANOVA was used to determine the significant difference among variables. All the figures have been rounded off to two decimal values and for the level of significance probability, level of 0.05 and 0.01 are used.

Results

The sample had 39 males and 21 females. Individuals were having education from professional courses to being post graduates: 6.8% individuals got lifetime psychiatric history and 40% had the family history of neurological conditions, psychiatric conditions, and physical conditions.

Psychosocial profile of internet users

Table 1 showed that moderate internet user had a higher mean value with regard to hours of use.

Neuropsychological profile of internet users

Table 2 showed that three groups differed significantly on digit symbol substitution errors: color trails A, color trail B, and Stroop task

Discussions

The present study revealed showed that the three groups (Normal, mild, and moderate user) differed significantly in terms of hours of use. A moderate user was spending more time on internet [Table 1]. These results also indicated that moderate internet users had significant impairment in focused attention, cognitive switch, response inhibition, and mental speed. [Table 2]. The second major finding indicates that mild user have performed relatively better than healthy normal controls on mental speed, sustained attention, cognitive switch (Color trails: trail A and B), and interference scores on Stroop test. The finding suggests that mild use augment cognitive performance on response inhibition, sustained attention, mental flexibility, and speed of processing. Mild internet use may facilitate neural plasticity and enhance cognitive performance.

Table 1: Comparison of means of hours of use, years of technology use (computer, smart phone, and tablet) between three groups

Variables	Normal internet users Mean±SD	Mild internet users Mean±SD	Moderate internet users Mean±SD	F	*P*
Hours of use	162.00±73.09	213.00±45.54	240.00±0.00	12.691	0.00**
Years of computer use	7.60±3.77	6.15±5.22	5.60±2.98	1.270	0.289
Years of smart phone use	4.20±1.39	3.80±2.93	4.20±1.90	0.226	0.799
Years of tablet use	0.25±0.78	0.95±2.39	1.15±2.00	1.291	0.283

Table 2: Comparison of means of cognitive variables between healthy internet users, mild internet users, and moderate internet users

Cognitive variables	Normal internet users Mean±SD	Mild internet addicts Mean±SD	Moderate internet addicts Mean±SD	F	*P*
Digit symbol substitution time taken	149.70±28.60	167.50±40.81	171.15±34.56	2.148	0.126
Digit symbol substitution error	0.20±0.41	0.15±0.36	0.70±1.08	3.773	0.029*
Color trail A TT	39.05±12.24	36.20±10.02	46.70±13.24	4.153	0.021*
Color trail B TT	83.45±19.72	79.55±26.97	105.60±21.00	7.583	0.001**
Stroop test word TT	45.30±4.69	47.80±7.81	49.30±7.34	1.792	0.176
Stroop test word E	0.00±0.00	0.45±0.38	0.15±0.48	4.433	0.016*
Stroop test color TT	71.85±8.54	74.50±14.56	82.15±15.7	3.222	0.047*
Stroop test color E	0.70±1.30	1.85±1.34	1.90±1.55	4.668	0.013*
Stroop test word color TT	125.46±20.02	122.25±20.76	147.25±34.80	5.423	0.007*
Stroop test word color error	2.00±2.02	4.85±5.92	5.95±3.67	4.731	0.013*
Stroop test WC-	27.68±2.53	28.87±4.24	30.644±4.50	2.977	0.059
Stroop test interference	97.71±18.58	93.37±19.56	116.60±32.28	5.169	0.009*

TT='Time taken; E=Error **P<0.01,*P<0.05.

The findings have been corroborated with the available literature on dysfunctional aspect of internet. In total, 575 students comprised of problematic and non problematic internet use were assessed for cognitive abilities as well as for academic performance. The academic results were poor among students with problematic internet use. The adolescents with problematic internet use got higher error rates for the abstract reasoning test, disturbance in cognitive functions as well as found to have higher degree of impulsivity in comparison to non problematic internet users, whereas other findings observed the relationship between internet addiction and cognitive abilities.[25]

Individuals with internet addiction disorder had showed impaired cognitive flexibilities as well as dysfunctions on response inhibition.[19] The neurobiological study that was carried out among internet addicts showed that diminished efficiency of response inhibition processes in the IAD group relative to healthy controls.[15] In a review of 97 studies, the results were generally consistent with the view that substance use disorders and addiction-like behavioral disorders were associated with impairments in inhibitory control.[26] Thirty-two internet addicts and 32 non internet-addicts were assessed using Event-related potentials for interpersonal relationship and loneliness. Participants viewed intimate-/conflict-relationship, happy/lonely, and neutral images. The accuracy rate of attention probes of internet-addicts was significantly lower than that of non internet-addicts, whereas there was no significant difference in the reaction time of attention probes. The differences were insignificant in the mean amplitude and latency of P1, N1, N2P3, and LPP between internet-addicts and non internet-addicts. The internet-addicts got higher loneliness scores than those of non internet-addicts. The finding implied impaired social cognitive function of internet-addicts.[27]

The limitations were observed in form of not having control of extraneous factors such as fatigue, anxiety which might have affected the performance. This study used cross-sectional design. The longitudinal design would have given better insight about the profile of cognitive abilities. The present study implied that mild use of internet augment the cognitive functioning.

Conclusions

The World Health Organization is going to include to gaming disorder as condition to be monitored in their draft of ICD 11; the study explored the neuropsychological profile of internet users as well as the pattern of use and its facilitative effects on cognitive functions. It will help in educating users for mild use of technology as well as allow to have research to strengthen our knowledge in neuropsychological aspect of internet use. The findings can be used at primary care setting by physician to screen technology use among treatment seekers as well as educate them. About facilitative effects of mild use of internet on cognitive functions.

Compliance with ethical standard

There was no conflict of interest in relation to present work as well as informed consent of the human subjects had been taken prior to inclusion in the study (27th Sept 2017).

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Conflicts of interest

There are no conflicts of interest.

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