

## Research Paper

## Internet Addiction and Psychological Health in Adolescent Indian Medical Students: A Cross-sectional Study

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## ABSTRACT

**Introduction:** With the presence of the internet in daily life, it has become crucial to explore its purposes, implications, and effects on the mental health of users. As adolescents are a vulnerable age group, this study was conducted on Indian medical students in late adolescence to learn how the internet impacts their lives. We aim to explore the severity of problematic internet use (PIU) in Indian medical students. We intend to assess its effects on psychological health and loneliness and correlate PIU with the purpose of using the internet.

**Methods:** A total of 185 first-year MBBS students of Bangalore Medical College and Research Institute (mean age: 18.07 years) were recruited and administered four questionnaires: Young's internet addiction test (YIAT20), UCLA loneliness questionnaire (version 3), general health questionnaire (GHQ12), and a self-administered questionnaire (to assess the purpose of internet usage).

**Results:** Out of 185 students, 67 were average users with complete control of their internet use, and 118 had PIU (113 with frequent, 5 with significant problems). PIU showed a significant positive correlation with psychological morbidity ( $r=0.34$ ,  $P<0.0001$ ) and loneliness ( $r=0.20$ ,  $P=0.01$ ). Daily mean use of the internet was mostly for social media (51.2%), followed by academics (20%), others (20%), and gaming (8.2%). PIU was significantly and positively correlated to social media usage ( $r=0.27$ ,  $P=0.00$ ) and negatively correlated to academics ( $r=-0.37$ ,  $P<0.0001$ ).

**Conclusion:** In our study, PIU was positively correlated to poor psychological health, loneliness, and use of social media. It showed a negative correlation with academics. This situation may suggest that PIU is linked to psychosocial implications. It may be worthwhile to correlate the purpose of use with the severity of PIU. Social media seems important in India as opposed to China, where gaming is the major concern. As some activities could be more addictive than others and result in a dysfunctional lifestyle, internet use must be regulated and used judiciously.

## Keywords:

Problematic internet use (PIU), Internet addiction, Social media, Indian medical students, Adolescence

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## Highlights

- Problematic internet use (PIU) was found in 64% of Indian medical students.
- 61% had frequent and 3% had significant problems; rest were average users.
- PIU was significantly correlated with psychological morbidity and loneliness.
- Daily use was maximum for social media (51.2%) having positive correlation with PIU.
- PIU was negatively correlated with use for academics.

## Plain Language Summary

Internet has become so integral that its impact on health is often overlooked. Some internet users report an inability to control or regulate internet use leading to negative consequences in overall wellbeing. Adolescence is an impressionable age when individuals are still developing their sense of identity and critical thinking. Using standard questionnaires, we found that 64% of adolescent Indian medical students had problematic internet use or PIU (61% having frequent, and 3% having significant problems). PIU was positively correlated with loneliness and psychological morbidity. Dysfunctional coping mechanisms may deteriorate mental health, if internet is used to reinforce distressing emotions. Eventually it leads to decrease in brain volume and cognitive control, perpetuating negative mental states in the long term. We also found that social media was most used daily by Indian medical students and was positively correlated with PIU. On the other hand, use of internet for academics had negative correlation with PIU. This suggests that certain applications may be more addictive than others and may vary among cultures, such as prevalence of gaming addiction in China. Thus, the importance of self-regulation cannot be emphasized more. Internet is an essential tool, but how we use technology makes all the difference.

### 1. Introduction

The internet has become indispensable in modern times, offering multiple benefits, such as information, recreation, and communication. However, excessive internet usage has been associated with many problems in some individuals, affecting their personal, professional, and social lives. This "loss of control" or "inability to regulate internet use" has been termed "internet addiction" at its extreme and has been compared to a phenomenon akin to substance abuse, leading to an inquiry into its mechanism, whether its disadvantages outweigh its advantages and if it can be regulated or curtailed by proper intervention (Brand et al., 2014).

The use of the internet and its after-effects vary significantly in different cultures and populations. Thus, few scientists agree with this term, and the field is still extensively researched worldwide. Though "internet addiction" has not been recognized as a clinical entity yet, internet gaming disorder (IGD) was included in diagnos-

tic and statistical manual of mental disorders, fifth edition (DSM5) as a "condition for further study" in 2013 (American Psychiatric Association, 2013).

Interestingly, the term "internet addiction" was proposed as a satirical hoax by a New York-based psychiatrist, Ivan Goldberg, in 1995 (New Yorker, 2015). Later, Young observed a young man who developed severe psychosocial problems due to excessive internet use and detected its close association with pathological gambling, a disorder of impulse control in DSM IV (Young, 1998a). She gave the first scientific description in 1996 and later developed an internet addiction test (IAT). She also suggested that there could be various types of internet addiction: Cyber-sexual addiction, cyber-relationship addiction, net compulsions, information overload, and computer addiction (Young, 2004). Many other single- and multiple-case studies were done later. Griffith considered it a subset of behavior addiction, meeting the 6 core components of addiction: Salience, mood modification, tolerance, withdrawal, conflict, and relapse (Griffiths, 2000). Davis, however, avoided the term internet addiction and preferred the term "patho-

logical internet use," referring to "addiction" as a dependency on psychoactive substances (Davis, 2001). Caplan suggested replacing the term "pathological internet use" with "problematic internet use" (PIU) after testing Davis' cognitive-behavioral model of PIU. He suggested that social isolation plays a more significant role in behavioral symptoms of PIU than does the presence of psychopathology (Caplan, 2007).

The terminology is still under debate as to whether it is a relatively less severe maladaptive coping mechanism akin to obsessive-compulsive disorder or impulse control disorder rather than addiction per se (Shapira et al., 2000). People with addiction generally use the internet excessively, ranging anywhere between 40 to 80 hours per week with individual sessions that could last up to 20 hours; however, timing is not considered a hallmark of internet addiction (Young, 2004). Instead, the loss of control is more crucial in assessing this disorder, as seen in various questionnaires. This phenomenon is being studied globally, and assessment tools and cut-off scores are yet to be standardized (Brand et al., 2014).

There has been a lot of speculation to assess if the "addiction" is real. The most important criterion to ascertain "addiction" is "unsuccessful attempts to control the behavior" or "loss of control" (Brand et al., 2014). Using imaging techniques, it has been found recently that prolonged internet use may result in grey matter atrophy, causing a decrease in concentration, memory, and executive ability (Brand et al., 2014). This phenomenon is very similar to other substance abuse and is associated with abnormalities in the dopaminergic system (Hou et al., 2012; Kim et al., 2011) and increased sympathetic nervous activity (Lin et al., 2014), which are related to one another. Increased sympathetic activity is linked to an increase in adrenaline and cortisol levels, which decreases immune function, especially in people with high levels of reported stress (McClelland & Jemmott, 1980; Reed et al., 2015) and psychological morbidity (Agrawal et al., 2021; Brand et al., 2014). Poorer school and work performance (Derbyshire et al., 2013), problems with interpersonal relationships (Kerkhof et al., 2011), neurological impairments (Kim et al., 2011; Kühn & Gallinat, 2014), physical health issues, such as obesity due to lack of physical activity as well as sleep disorders (Vandelaan et al., 2009) like insomnia, poor sleep duration, latency, and quality have also been documented (Li et al., 2015).

The objectives of this study were to explore the severity of PIU in Indian medical students in their adolescence, to assess its relationship with psychological health/loneliness, and to correlate PIU with the purpose of use.

Although internet abuse is a crucial issue globally, very few studies have explored the situation in India. Adolescents are a particularly vulnerable group owing to their higher experimental and risk-taking behaviors (Young, 1998b), lesser cognitive maturity (Casey et al., 2008), and limited critical thinking ability (Agrawal et al., 2021). Adolescents struggle with issues of self-identity and social adjustment. This study was done on an academic group of Indian medical students in their late adolescence to assess how the purpose of their use impacts their psychosocial health.

## 2. Materials and Methods

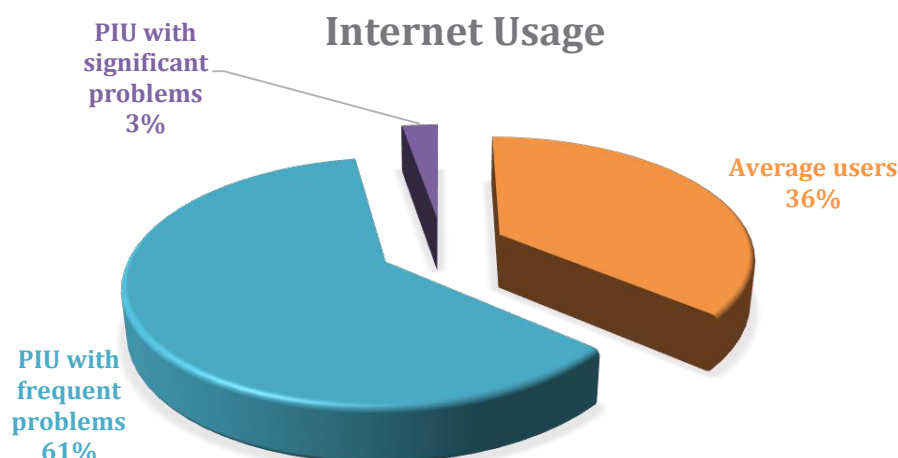
### Study subjects

A total of 185 (105 males, 80 females) healthy first-year MBBS (bachelor of medicine, bachelor of surgery) students of Bangalore Medical College and Research Institute (BMCRI) of age group 17-19 years were included in the study (mean age: 18.07 years). The exclusion criteria consisted of any previous history of anxiety/depression/psychiatric problems, drug history of antidepressants/tranquilizers, etc. thyroid disorders, or history of substance abuse.

### Study instruments

#### Young's IAT (YIAT20)

The IAT was used to determine the severity of the internet addiction. The test contains 20 self-reported items, each rated on a scale from 1 to 5, where a score of 1 is defined as "rarely" and 5 as "always." It includes questions on how internet behavior affects the daily lives, social intercourse, sleeping patterns, and feelings of the individual (Faraci et al., 2013). High scores indicate greater problems associated with internet use. As per a recent meta-analysis (Frangos et al., 2012), the scoring was done as follows: 20-39, average users with complete control; 40-69, internet usage with frequent problems/"possible addicts;" and 70-100, internet usage with significant problems/"addicts." Since the cut-off scores for addiction have not been established, we have considered scores  $\geq 40$  as PIU. It is a more acceptable term in the scientific community.



**Figure 1.** Internet usage (YIAT)

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PIU: Problematic internet use.

### UCLA loneliness questionnaire (version 3)

The revised UCLA (University of California, Los Angeles) loneliness scale (version 3) consists of 20 statements designed to assess the degree of loneliness. Participants respond to each question using a 4-point scale ("never" to "often"), and each item is scored from 1 to 4, giving the total score from 20 to 80. A higher score indicates a higher severity of loneliness. The measure has high internal consistency (coefficient  $\alpha=0.89-0.94$ ) and a test re-test correlation over two months of 0.73 (Russell, 1996).

### General health questionnaire (GHQ-12)

GHQ-12 is used to detect psychological distress with high sensitivity and specificity. Developed in the 70s, it detects non-psychotic psychiatric problems such as depression, anxiety, and related psychiatric morbidity. Studies of GHQ-12 have yielded high validity coefficients when administered in several languages and have been used in countries including India. It consists of 12 questions on a Likert scale with best to worst scores (0-3) (Goldberg, 1972; Goldberg et al., 1997).

### Self-administered questionnaire

This questionnaire assessed the duration and purpose of internet use in terms of "% of average time spent using the internet daily" in four areas: Social media, gaming, academics, and others (e.g. hobbies, movies, recreation). For example, out of 100% of the time spent using the internet daily, what is the rough proportion of time (in %) they use for social media, academics, others, or gam-

ing? The exact duration in hours could not be assessed accurately as the participants could not quantify the time spent using the internet.

### Statistical analysis

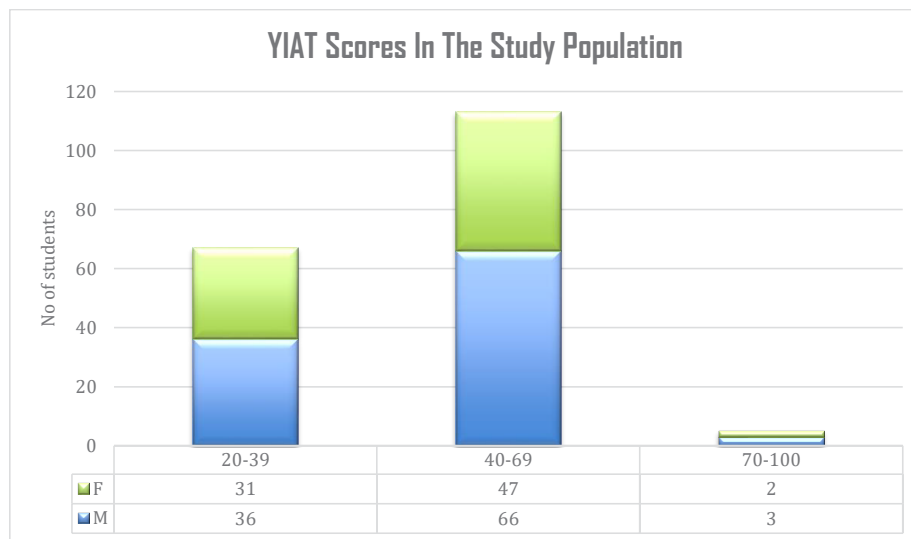
The obtained data are represented as Mean $\pm$ SD. The sample size was calculated based on a recent study on Indian medical students that found internet addiction to be 58.87% (Chaudhari et al., 2015). The formula used was  $n=Z^2 p(1-p)/E^2$ .

Z for  $\alpha=0.5$  is 1.96. The unpaired t-test and analysis of variance (ANOVA) were used to compare mean values between the groups. The Pearson correlation was used to find the strength of the association.  $P<0.05$  (two-tailed) were considered significant. This cross-sectional study was done per the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines.

## 3. Results

### Prevalence of PIU in the study population

The YIAT was divided into three categories: Average users (20-39), frequent problems/ possible addicts (40-69), and significant problems/ addicts (70-100). Scores above 40 were considered PIU. Out of 185 first-year students, 36% were average users with complete control over internet use, and 64% of medical students showed PIU (61% were possible addicts with frequent problems, 3% were addicts with significant problems) (Figure 1).



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**Figure 2.** Gender differences in PIU in the study population

Notes: X-axis represents YIAT scores: 20-39- average users with complete control, 40-69-PIU with frequent problems, and 70-100-PIU with significant problems)

PIU: Problematic internet use.

### PIU and gender differences

There was a slight preponderance of PIU in males (65.7%) as compared to females (61.25%) (Figure 2) but no significant difference was found between the two genders in internet use ( $P>0.05$ ) (Figure 2, Table 1).

### GHQ and UCLA scores in the study population

A significant positive correlation was found between DOCS (dimensional obsessive-compulsive scale) scores and GHQ ( $r=0.34$ ,  $P<0.01$ ) as well as loneliness ( $r=0.20$ ,  $P=0.01$ ) (Figure 3).

### PIU and purpose of use

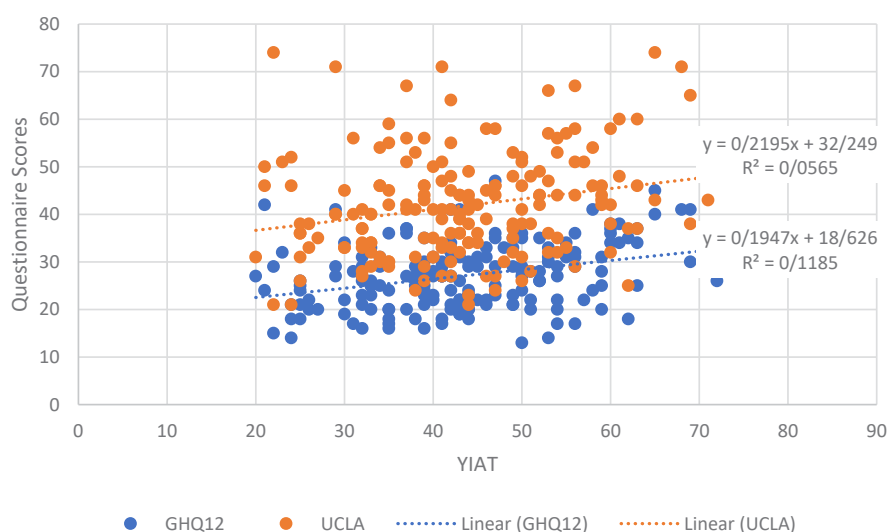
In our population, the maximum average % of total daily time spent using the internet was mostly on social media (51.2%), followed by academics (20%), others (20%), and gaming (8.2%). PIU had a positive correlation with social media ( $r=0.27$ ,  $P=0.00$ ) and gaming ( $r=0.14$ ,  $P=0.05$ ), whereas a negative correlation with academics ( $r=-0.37$ ,  $P<0.0001$ ) and other purposes ( $r=-0.96$ ,  $P=0.20$ ) with significant values for social media and academics (Figure 4).

**Table 1.** Comparing PIU scores between the two genders

YIAT Scores	Male		Female		t	P
	Mean±SD	No.	Mean±SD	No.		
20-39	32.86±4.88	36	30.55±5.96	31	1.75	0.08
40-69	49.94±7.78	66	49.98±7.4	47	-0.03	0.97
70-100	74±4.36	3	73.5±3.53	2	0.13	0.90
Total score	44.77±11.70	105	43.04±12.60	80	0.97	0.33

PIU: Problematic internet use; YIAT: Young internet addiction test.

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**Figure 3.** Correlation of YIAT scores with GHQ and UCLA loneliness scores

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YIAT: Young internet addiction test; GHQ: Generalized health questionnaire.

## 4. Discussion

### Background characteristics and extent of use

Among 185 medical students, 64% had PIU (61% had frequent problems, and 3% had significant problems). This finding is in agreement with previous studies. In a study, 58.87% of Indian medical students had internet addiction, out of which about 51.42% were mildly addicted while 7.45% were moderately addicted to the internet (Chaudhari et al., 2015). However, due to the heterogeneity of study samples and different diagnostic tools used, there is a marked variation in the prevalence of PIU globally (Brand et al., 2014).

Slight preponderance was found in males (65.7%) compared to females (61.25%). However, no significant difference was found between the two genders. Another study suggests girls are more mature and self-disciplined and pay more attention to information and knowledge provided by the internet compared to boys of the same age, who take the internet as one of life's necessities. Regarding disposition, boys are likelier to indulge in the adventurous, exciting, novel and challenging things. Some studies have shown that boys are more prone to be addicted to online games, and girls are more prone to be addicted to online relations (Ge et al., 2014).

### Association with psychological morbidity

We also found a significant association of PIU with GHQ scores suggestive of psychological morbidity such as anxiety/depression ( $r=0.34$ ,  $P<0.0001$ ) and UCLA loneliness scores ( $r=0.20$ ,  $P=0.01$ ). Though it is a cross-

sectional study and the causal association cannot be determined, there are some theories to explain the association between psychosocial factors and PIU. Lack of social support in real life and feelings of social isolation or loneliness are accounted as the main factors contributing to the development of internet addiction (Davis et al., 2002). Certain psychopathological symptoms have been proposed to cause generalized internet addiction, such as depression and social anxiety (Whang et al., 2003) as well as dysfunctional personality facets like shyness, low self-efficacy, vulnerability due to stress, and tendency to procrastinate (Brand et al., 2014; Caplan, 2007; Chak & Leung, 2004; Ebeling-Witte et al., 2007; Hardie & Tee, 2007; Whang et al., 2003). In addition, specific internet addiction may also be found in individuals with specific predispositions for certain applications (Brand et al., 2014). This condition may then intensify the overuse of the internet as a (dysfunctional) coping strategy to fulfill expectancies from the internet, help distract from problems, escape from reality (positive reinforcement), or reduce negative emotions (negative reinforcement) (Figure 5) (Brand et al., 2014).

Unfortunately, the use of the internet as a coping strategy for negative psychological states may also perpetuate these states in the long term (Li et al., 2015). Eventually, the cognitive control of an individual becomes more difficult due to the strong reinforcing character of specific internet applications, causing a reduction in prefrontal control, leading to decreased grey matter, executive, and decision-making ability (Brand et al., 2014; Thatcher et al., 2008). The most consistent findings from the imaging studies available are atrophy in the prefrontal cortex (i.e.



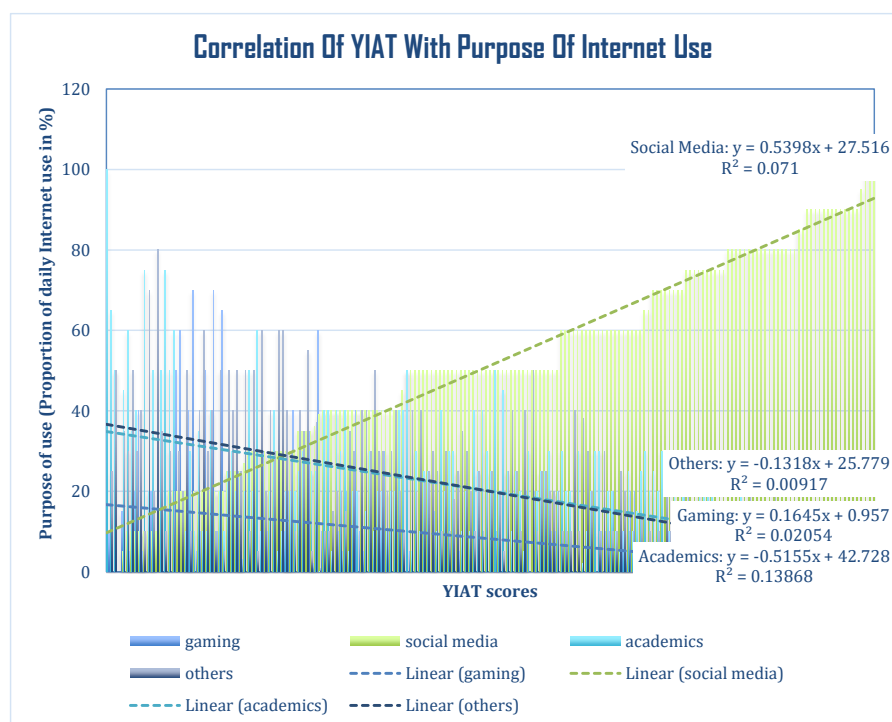


Figure 4. Correlation of YIAT scores with purpose of internet use

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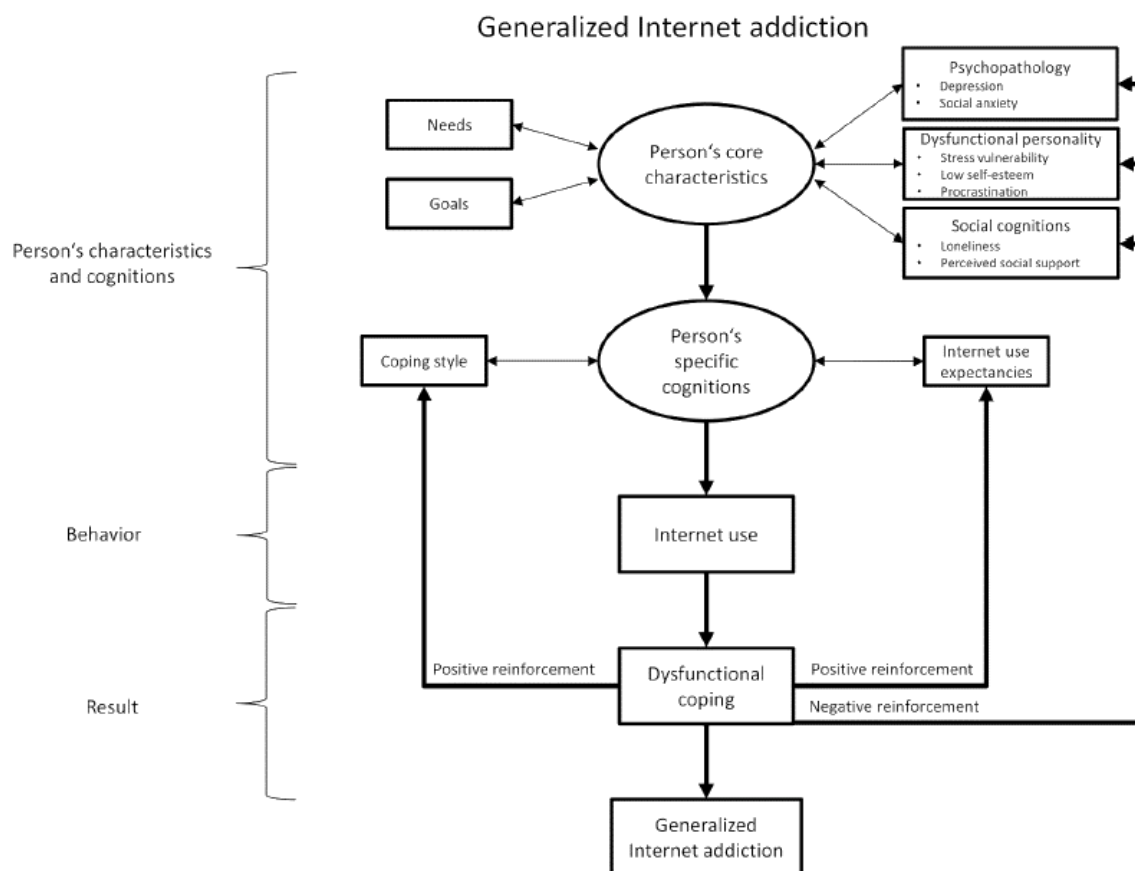
orbitofrontal cortex, anterior cingulate cortex, and dorsolateral prefrontal cortex), striatum, and insula (Lin & Lei, 2015). Diffusion tensor imaging abnormalities also demonstrated decreased connectivity between the striatum and the inferior frontal gyrus, a connection known to be involved in inhibitory control (Chambers et al., 2009; Swick et al., 2011). This condition might eventually lead to an inability of the prefrontal cortex to regulate the limbic system and may contribute to the persistence of online activity despite personal distress, symptoms of psychological dependence, and diverse negative consequences, thereby exhibiting more impulsivity (i.e. deficits in response inhibition) in certain individuals (Cao et al., 2007; Dalbudak et al., 2013). Individuals with internet addiction are known to have difficulties with response inhibition, which likely contributes to their propensity to relapse in the presence of internet-related cues. Therefore, poor inhibitory control, a decreased ability to suppress automatic and habitual behaviors (Lin et al., 2015) and the role of 'reward pathways' could explain why it is so difficult for some individuals to control their internet use and why they experience "craving" for internet akin to substance abuse (Brand et al., 2014).

### Correlation with the purpose of use

In our study population, we found out that the daily use of the internet was maximum for social media (51.2%),

followed by academics (20%), other purposes (20%), and gaming (8.2%). There was a significant positive correlation between PIU with social media and a negative correlation with academics. This finding could suggest that certain applications could have a relatively higher addictive potential compared to others.

Social media seems to be a priority for our study population. Research suggests that some young people may be more willing to disclose information on a social network site (SNS) than others (Christofides et al., 2009). While SNS use may result in unhealthy online interactions for some (O'Keeffe et al., 2011), it may provide needed opportunities for many vulnerable youngsters (Burke, 2018) with potential mental health benefits, including socialization, facilitation of supportive relationships, belongingness, self-esteem, identity formation, communication, and learning (O'Keeffe et al., 2011). Some identified risks include cyberbullying, harassment, sexting, and privacy concerns (O'Keeffe et al., 2011; Rice et al., 2014). Decreases in depression have been documented by longitudinal research (Bessière et al., 2010) and re-establishing friendships following social withdrawal (Veretilo & Billick, 2012). However, SNS-induced depression has also been reported with greater depressive symptomology and negative affect (Feinstein et al., 2013; Takahashi et al., 2009). The intervention content, safety, and type of interaction may



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**Figure 5.** The proposed model on the development and maintenance of generalized internet addiction (Brand et al., 2014)

mediate this bidirectional effect of SNS on depression. For example, positive online interactions may increase social support and reduce depression, and negative online interactions (or with a negative focus) may increase depression and perceived burden (Ge et al., 2014). Qualitative differences among young people may also play a role; for example, those higher in hopelessness (a key predictor of suicidal ideation) may be more likely to engage in blogging-type sites, e.g. online support groups (OSGs) versus sites focused on briefer posts and content, which may in turn help alleviate depression (Dunlop et al., 2011; Griffiths et al., 2012).

One of the longitudinal studies done on female college students to assess media use and academics concluded that cell phone use and social networking distract from concentration on academics. These social media might reflect personality differences (Wilson et al., 2010) or the prioritization of social activities over academics (Davis et al., 2002). It has been suggested that the major predictive variable of internet addiction lies in its function of releasing. The informative function is not a factor in

the increase in internet addiction degree. This issue may explain the significant decrease in internet use for academic purposes and our study's positive correlation with social media.

Other internet uses may include online shopping, watching movies and videos, pursuing hobbies, reading news, and pornography. Results of a study indicate that increased email and chat room/instant messaging hours are associated with decreased depressive symptoms, while increased internet hours for shopping, playing games, or research are associated with increased depressive symptoms (Morgan & Cotten, 2003). Literature suggests that an overlap between various addictions is quite common (Sussman et al., 2011), and addictive behaviors co-occur. Problematic computer (game) use could coexist with pornography (Voss et al., 2015), substance use (Grüsser et al., 2005), or gambling (VAN Rooij et al., 2014; Wood et al., 2007). Patients are less likely to be forthcoming about pornography use due to the sensitive and personal nature of the subject.



In our study population, gaming was the least important preoccupation where the internet was considered. This finding contrasts with Chinese people, where gaming is a primary subtype of internet addiction (Li et al., 2015). The appendix of the DSM-5 also includes IGD as a "condition for further study" (American Psychiatric Association, 2013). There is evidence that computer game practice improves the spatial performance and iconic (image representation) and visual attention skills of adolescents (Subrahmanyam et al., 2000) and may be associated with decreased depressive mood and improved self-esteem (VAN Rooij et al., 2014). However, when indulged excessively, gaming may decrease psychosocial functioning and lower grades (VAN Rooij et al., 2014). It is proposed that pleasure, excitement, social interactivity, increased immersion, and seemingly endless achievements associated with certain activities like gaming cause neuropsychological stimulation (Yee, 2006) of the hypothalamus-pituitary-adrenal axis and endogenous dopaminergic reward pathways resulting in increased heart rate, blood pressure, and sympathetic tone (Chaput et al., 2011) as seen by functional magnetic resonance imaging fMRI scans (Ko et al., 2013; Sun et al., 2012). For instance, built-in music adds to the immersive environment of the video game, stimulating the hypothalamus-pituitary-adrenal stress response and release of cortisol (Hébert et al., 2005). Playing the game competitively with other human players results in higher levels of testosterone in men (Voss et al., 2015; Zilioli & Watson, 2012) and an increased food intake, regardless of appetite sensations (Chaput et al., 2011). It is 'a kind of operant conditioning where the individual feels rewarded and is more likely to engage in that behavior again, causing a pattern similar to substance abuse (Brand et al., 2014). Moreover, it provides an escape from rigid parenting structure, in addition to the satisfaction players feel when they advance levels or complete tasks.

Internet usage may have cultural differences and may reflect a society's needs, preferences, and priorities. Also, certain applications of the internet, such as social media interaction and gaming could be more addictive than others, thus highlighting the importance of self-regulation.

Technology is a double-edged sword. It is how we use it that makes all the difference. Excessive time spent on web-based activities, neglect of activities such as sleeping, physical exercise, social interaction, and symptoms of withdrawal when those activities cannot be accessed are the reasons why internet use affects mental health (Block, 2008; Petry et al., 2014). Thus, internet use is not intrinsically harmful but depends on the activity one

engages in and how it affects the individual. So, it seems possible that the internet has some benefits when used to a certain extent, but negative consequences might overshadow these properties when used excessively. Therefore, interventions to reduce internet use negative mental health effects could target the negative consequences instead of the internet use itself (Hökby et al., 2016). "Integrated internet addiction prevention program" could help individuals self-regulate excessive internet use (Mun & Lee, 2015). Since the internet has become indispensable in everyday life, future efforts must be made towards developing protocols to integrate the beneficial effects of the internet within a safe and supportive framework and provide positive alternatives to internet usage (Rice et al., 2014).

There are some limitations of this study. First, the causal association could not be assessed since it is a cross-sectional study. Second, accurate information about the duration of internet usage could not be collected and correlated with the severity and purpose of PIU.

## 5. Conclusion

Based on our study, the severity of PIU had a significant positive correlation with poorer psychological health and loneliness, internet use for social media, and a decrease in academic use. There could be cultural preferences in internet usage, and specific applications may be more addictive than others. This outcome may depend upon personality, needs, and psychosocial factors. Thus, efforts must be made so that internet use is regulated and used judiciously, especially in adolescents.

## Ethical Considerations

### Compliance with ethical guidelines

All participants gave informed consent. The study design was cross-sectional and descriptive. Ethical clearance was obtained from the Ethics Committee of Bangalore Medical College and Research Institute (BMCRI), Bengaluru, India.

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This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

### Authors' contributions

Conceptualization, investigation, data collection and writing the original draft: Megha Agrawal; Methodology

and data analysis: Megha Agrawal, and Sowmya Rajaram; Review and editing: Sowmya Rajaram, Girija Kumar; Supervision: Sowmya Rajaram, and Girija Kumar.

### Conflict of interest

The authors declared no conflict of interest.

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