

Internet addiction: a new addiction?

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ABSTRACT

The internet today has become an integral part of daily life that facilitates communication, education, and entertainment. The behavioral pattern of excessive internet usage has similarities to substance addiction, such as tolerance, withdrawal, repeated failure to reduce or quit, and impairment in daily life. Yet, there is no consistent physiological change that accompanies excessive use of the internet, as there is in excessive substance use. Neurological and neuroimaging studies of excessive internet users show biological changes in the prefrontal cortex that are similar to those found in other addictive syndromes. Brain structure changes also occur in the temporal cortex and ventral striatum, compromising executive function in planning and reasoning and increasing impulsive risk, resulting in loss of control over internet use. Of all the potential online applications known to cause addiction, only internet gaming disorder has been selected in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) as a condition for further study.

KEYWORDS behavior addiction, internet addiction, mental disorders

Technological development has increased rapidly in recent decades, especially in the field of digital technology, including internet networking.¹ The digital revolution, with its rapid growth of electronic devices, has transformed how we communicate, educate, and entertain ourselves, as well as how we behave as individuals in society. In this era, teenagers and young adults have already been exposed to digital technology from the beginning of their lives; therefore, children and adolescents are greatly affected by this digital technology. They have been called the digital, millennial, or Y generation.^{1,2} This generation is more susceptible to internet addiction due to changes in modern culture where parents are busier and lack control over their children, higher academic

and job expectations, and exposure to marvelous technological developments that fulfil their needs and help them to escape their problems. Because technology has become an integral part of everyday life, the distinction between excessive and functional internet use is unclear.³

China Internet Network Information reported that 27.3% of the 485 million people who use the internet are teenagers.⁴ These data were supported by research in six countries in Asia showing that 62% of teenagers had cellular phones, and approximately 68% of teenagers in Hong Kong use the internet for networking every single day. A similar situation is also occurring in Indonesia; even though the growth of the internet was slower than in other developing countries, the proportion of

individuals using the internet increased from 0.9% in 2000 to 17.1% in 2014.⁵ The Ministry of Communication and Information, Republic of Indonesia teamed up with the United Nations Children's Fund and researched the pattern of internet use in teenagers. The subjects were 400 teenagers age 10–19 years in Indonesia, including urban and rural areas; the result showed that approximately 80% of teenagers, especially in Jakarta, Banten, and Yogyakarta Special Region, were using the internet in their daily lives. Moreover, data also report that Indonesia has the fifth largest number of Twitter accounts in the world. A study of Jawa Pos newspaper in 2000 showed that communication via internet networking, or chatting, is the most (62.3%) frequently used application among 252 High School students in Surabaya. The prevalence of internet addiction in teenagers in Asia tends to be higher than in the US or Europe, and cultural differences are partly responsible for this. Asian teenagers tend to have difficulty expressing themselves that leads to self-expression in the cyber world.⁴

Widespread internet usage gives teenagers an advantage by facilitating access to information, communication with friends, networking on social media, and entertainment. Nevertheless, with all these advantages comes a new pathology. There is an emerging risk of excessive internet usage, especially in teenagers. Early exposure to technology and its excessive use are related to behavioral problems among children and young adolescents.⁶ Teenagers are in a stage of development characterized by a drive to discover something new, called novelty seeking, characterized by bold risk-taking and peer sensitivity; they are also in a period of development of executive function, such as self-regulation.^{7,8} This internet phenomenon could interfere with their mental development as they search for their own identities, as well as the formation of self-image.⁵ Excessive internet usage could develop into internet addiction. The syndrome regarding compulsive interactive media use is termed problematic interactive media use. In this syndrome, there are four prominent presentations: gaming, social media, pornography, and information seeking, and it includes uncontrolled online searches of any textual or visual information, including watching videos or television series.²

The excessive behavioral pattern of internet use has many underlying similarities to substance addiction. The causation of this behavior is similar to

that of other addictive syndromes, according to several neuroimaging studies. Changes in brain structure might impair the executive functions of planning and reasoning, increasing the risk of impulsivity and leading to addiction. Teenagers with internet addiction exhibit compulsive behavior that is difficult to control. This could be explained by a few studies that reported a disturbance in the frontal region of the brain, especially the prefrontal dorsolateral cortex, the area responsible for cognitive function, motivation, and impulse control. Moreover, decreased volume was also found in the substantia grisea at the left cingulate anterior, left cingulate posterior, left insula, left lingual gyrus, and prefrontal dorsolateral cortex. These differences could also be seen on functional MRI examination, termed the fMRI blood oxygen level dependent (BOLD) examination. The fMRI BOLD is a modality for observing anatomical structure and its function based on oxygen level necessity when there is activity in the brain. On fMRI BOLD examination, hyperactivity was found in the prefrontal dorsolateral cortex and amygdala when an image about their internet addiction was shown to the teenagers.^{9,10} The brain regions related to internet addiction can be seen in Figure 1.

Cognitive function, executive function, and decision making

Prefrontal cortex (PFC): the PFC is divided into the orbitofrontal cortex (OFC) area, the dorsolateral prefrontal cortex (DLPFC), and the rostral prefrontal cortex (RPF). Disorganization of the DLPFC and RPF areas leads to cognitive dysfunction, incorrect decision making, and concrete inflexible thoughts. The PFC is associated with the craving process in internet addiction. When a person with internet addiction is shown a signal associated with the type of addiction they have, the PFC will show an increase in activity. The PFC is also responsible for decision making. Individuals with addiction will respond quickly to signals related to their addiction. The PFC area in adolescents is not yet mature, so internet addiction that occurs in this age group will affect the processes of transformation and maturation of brain structures.^{11–13}

Anticipation of reward, emotional processing, decision making, impulse control

Inhibition of the OFC area will lead to poor impulse control and inappropriate behavior with internet addiction. In people with internet addiction, there are

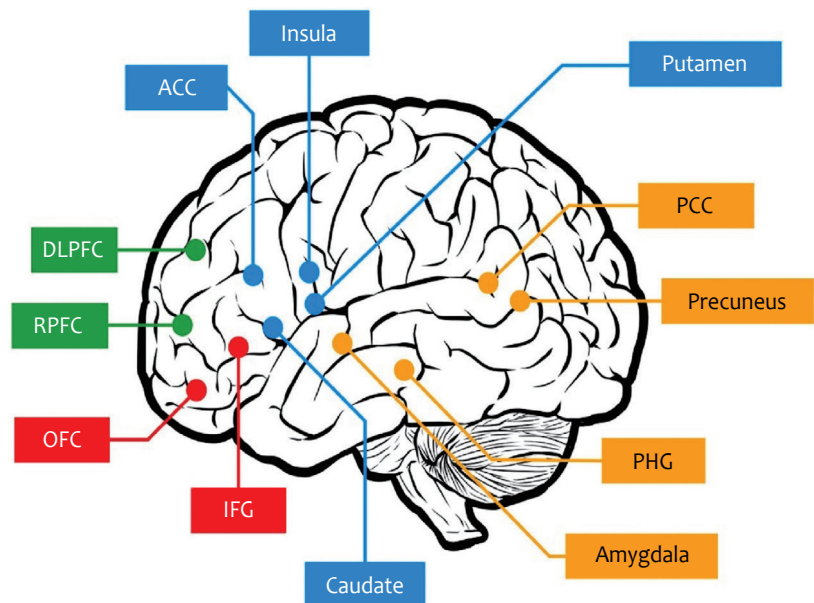


Figure 1. Brain regions related to internet addiction

ACC=anterior cingulate cortex; DLPCF=dorsolateral prefrontal cortex; IFG=inferior frontal gyrus; OFC=orbitofrontal cortex; PCC=posterior cingulate cortex; PHG=parahippocampal gyrus; RPFC=rostral prefrontal cortex

changes in the OFC and inferior frontal gyrus (IFG) regions that will affect the anticipation of rewards, emotional processes, decision making, and impulse control. In an internet gaming disorder study, activity in the left OFC was often correlated with impulsivity in patients.^{14,15}

Emotional and memory processes

Someone with internet addiction shows greater activation of the parahippocampal gyrus (PHG), posterior cingulate cortex (PCC), precuneus, and amygdala in response to game signals. These brain areas are associated with craving processes that involve emotional functioning (fear, sadness, and anxiety), memory, motivation, attention, and empathy. Precuneus activation creates visual, imaginary, attention, and memory processes, which later are followed by happy memory coding by the parahippocampal area.^{15–18}

Craving and conflict processes

The anterior cingulate cortex (ACC), insula, putamen, and caudate are associated with the craving process in internet addiction and conflict processes. The ACC will activate a strong desire to play the online game or connect to the internet, then the DLPFC will be activated to select and plan to play an online game or connect to the internet. This is evidenced by a study in which the researchers found that several areas,

especially bilateral DLPFC, displayed higher activity in an internet addiction group than in a control group. After cessation of excessive internet usage, activity in the right DLPFC and left parahippocampal gyrus appeared lower than before.^{15,16}

Internet addiction creates a serious problem for the mental and physical development of teenagers, therefore an accurate diagnostic tool is needed so that treatment can be administered immediately, because, as with most behavioral problems, the earlier the condition can be identified, the easier it is to correct. Moreover, it is also important to distinguish between normal child or adolescent behavior from which is pathologic and requires therapeutic intervention. Currently, there is no measurement instrument that is universally useful for making a definitive diagnosis, because no gold standard has yet been established. The diagnostic criteria for internet addiction has not yet been included in the Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition (DSM-5). There are many potential addictions that stem from online activity, but only internet gaming disorder was singled out in DSM-5 as a condition for further study. The definition of and criteria for internet addiction should be examined further.⁵

Concept and definition

The concept of internet addiction is rooted in behavioral addiction, which has similar behavioral

patterns and biological causations to substance addiction. In recent years, behavioral addiction was determined according to the same criterion as substance addiction: tolerance, withdrawal, repeated failure to reduce or quit, and impairment in daily life. Neuroimaging studies from behavioral addiction also showed a connection between changes in brain structure and those in brain function related to reward, emotion, executive function and attention, decision making, and cognitive control.^{19,20} Several studies have shown a connection between the cycles of substance and behavioral addiction. Some behavioral addictions, including internet usage, video gaming, gambling, eating, sex, shopping, pornography, and exercising, have been described as addiction by some researchers, but it is not universally accepted by the medical community. Even though they demonstrate craving, increasing tolerance, inability to abstain, and diminished awareness of use-related problems, these behaviors do not feature the consistent, reproducible physiologic changes in heart and respiratory rates, blood pressure, and galvanic skin response that is seen in addictive use and withdrawal from substances such as narcotics, alcohol, and tobacco.² Behavioral addiction was introduced as a new category of psychiatric disorders in Substance-Related and Addictive Disorders on DSM-5, with pathological gambling as a diagnosis and internet gaming disorder as a subtype.

Four components were originally suggested as essential to the diagnosis of Internet Addiction Disorder for DSM-5 inclusion: excessive internet use, withdrawal, tolerance, and lastly, adverse consequences like arguments, lying, poor performance at school, or a decrease in work achievement, social isolation, and a feeling of exhaustion.²¹ The symptoms of internet addiction are usually associated with substance-related addiction, namely salience or preoccupation, tolerance, mood modification, loss of control, withdrawal, denial and concealment, and relapse. Salience is characterized by the idea that all that matters is the behavior, and everything else is not important. Tolerance is one of the main criteria for internet addiction and is defined as a need to increase the duration of internet usage. There is a controversy over the definition of tolerance; instead of the increasing amount of time, the criterion should focus on the decrease in satisfaction. This means that individual experiences decrease the level of gaming

satisfaction because of prolonged gaming activity.^{6,22} Based on the theory of tolerance, increasing levels of dopamine are necessary for the brain to create the same feeling of pleasure and gratification. Over time, more of the behavior is needed to obtain the same pleasurable effect. The mood-modifying aspects of internet use have been observed in recent decades. Mood modification occurs because people want to change their mood or overcome their depression and escape from reality. Furthermore, if they cannot use the internet, people often find difficulties and conflicts in real life because of their aggressiveness to fulfil their desire for internet use.

When they can no longer control their behavior and psychosocial consequences, people begin to seek professional assistance. Withdrawal symptoms often occur after cessation of internet use. The symptoms that can be experienced by patients were shaking, nausea, high temperature, apathy or lack of interest, and bowel and gastrointestinal problems. These were explained by an increasing need for dopamine in the brain to re-establish its chemical equilibrium. Therefore, the brain requests more stimulus of the behavior to create the same level of pleasure. There is also a difference between depressive and aggressive withdrawal symptoms. The withdrawal symptoms of aggression could be expressed as verbal and physical conflicts. Otherwise, the symptoms of depression can be seen in severe cases and can lead to suicidal threats or attempts. People who have internet addiction typically tend to be closed about their addiction, so they hide it from their parents or others. On one hand, adolescents and young adults do not realize that their condition could lead them to a severe addiction. On the other hand, if they realize their behavior is wrong, they will try to hide it and appear as normal as possible to minimize their parents' and others' concerns. The final characteristic symptom of addiction psychopathology that appears in addicted people is relapse. Individuals who suffer from addiction could experience relapse, possibly several or many times.⁶

Young¹⁹ defined internet addiction as any online-related, compulsive behavior which interferes in activities of daily life and social interaction. Excessive use of the internet became one of the coping mechanisms to avoid problems and negative feelings. When the individual uses the internet, they go through negative reinforcement; it is an uncomfortable feeling

because of the problems that they face, but at the same time, they also feel positive reinforcement because when they use it, their negative emotion and loneliness subsides. In individuals who have a specific pathology and use the internet as a way to carry out their pathologic behavior, they obtain some sort of gratification, and it becomes a form of positive reinforcement to them and causes them to use the internet continuously and excessively.²³

Another definition of internet addiction disorder by Tao et al²⁴ explains that there are eight symptoms of internet addiction: (1) preoccupation: a strong desire to use the internet and an inability to stop thinking about previous online activities; (2) withdrawal: dysphoric mood, anxiety, irritability, and boredom after several days without internet activity; (3) tolerance: marked by an increase in internet usage to achieve same level of pleasure; (4) difficult to control: persistent desire and/or inability to control, cut back, or discontinue internet use; (5) disregard for harmful consequences: neglect of the persistent or recurrent physical or psychological problems because of excessive internet use; (6) loss of social communications and interests: loss of interest in previous hobbies and entertainment except the desire for internet use; (7) alleviation of negative emotions: use of the internet to escape or relieve a dysphoric mood (such as helplessness, guilt, or anxiety); (8) hiding from friends and relatives: covering the truth about internet use, such as the money and time spend on internet involvement to family, a therapist, and others.²⁴ There are still many judgments about the diagnosis of internet addiction that still require further research and study.

Kimberly Young was the first person to introduce the term internet addiction with the purpose of showing a connection between behavior and impulse control disorder.⁸ Her first publication is about a housewife who was going through addiction to virtual communication using the internet. Young stated that not only people who are adept with technology but the whole population can be susceptible to internet addiction. Young et al²⁵ categorize internet addiction into five subtypes.

Cyber sexual addiction

Cyber sexual addiction could be described as viewing pornographic content or online sexual communication. The most common form of cybersex is sexual chatting or talking between two or more

individuals, which may or may not be followed by masturbatory activities.²⁶ Sexual content on the internet can be found easily because sexual things in the real world can be translated in many ways onto the internet. Ready availability of sexual material online plays an important role in the increase in individuals seeking help because of cyber sexual addiction and compulsivity that has disturbed their lives. However, not all online sexual activity has negative impacts on its consumer.²⁷ Nearly 80% of online sexual activity is aimed at recreational purposes and does not create any significant problems based on an earlier study by Cooper et al.²⁸ Furthermore, appropriate use of the internet could help youth and adults to find information on sex or issues such as sexually transmitted infection prevention, contraception preferences, and other health information about sexuality.²⁷

Every online technology can be used for a sexual purpose. Through the World Wide Web, displaying text, graphics, and multimedia about sexual things is not difficult. Sexual purposes can be served easily by seeing pornographic images, sexualized chatting, video streaming, or accessing other sexual areas.²⁷ The latest phenomenon for obtaining sexual pleasure is sexting, which refers to sending and receiving sexually explicit photos/videos and/or text, such as nude or partially nude images, and may or may not meet the legal definition of child pornography. These images/videos can be exchanged using a variety of technologies, including social media, text messaging, cell phone apps, webcams, and digital cameras. The research shows that motivation for engaging in sexting behavior differs between males and females. Females reported feeling increased pressure to send sexts as the primary motivation for the behavior. Although males may feel pressure to engage in sexting, it appears to be more related to showing off to their male peers rather than to please their romantic partners.²

All youth who engage in sexting behaviors are not the same. Wolak and Finkelhor developed a typology for understanding the difference between youth who engage in sexting behavior in two main categories, aggravated and experimental.²⁹ Aggravated cases involve criminal or abusive components, including abusive behavior among minors such as sexual abuse, blackmail, fraud, or threats. For experimental sexting, there may have several motivating factors, romantic purposes remaining the most common one. Most

youth indicated that they were either in a committed relationship with the person they sexted with or trusted that individual with their photos/videos. When already in a romantic relationship, youth also use sexting behaviors to flirt or express general sexual interest in potential romantic partners. Experimental sexting appears to be part of a youth's typical development, including his or her sexual curiosity, creating sexual interest, finding romantic partners, and getting attention from others.²⁹

The clinician should perform a comprehensive assessment to determine whether an individual has moved into one of the problematic categories of cybersex.²⁷ Schneider explained three basic criteria for defining this condition, they include repetitive sexual thoughts and an inability to stop and control their behavior despite knowing the consequences.³⁰ Furthermore, evaluation of the interaction between the intensity and frequency of online sexual behavior engagement requires consideration. Online sexual behavior that is carried out frequently and repeatedly, even if at a low intensity, can have a significant impact and consequences.²⁷

The internet sex screening test is a self-administered tool for evaluating the frequency of usage and considering the level of impact of cyber sexual behavior. It consists of 25 core items and nine general offline sexual compulsivity items. Delmonico and Miller reported a significant relationship between offline and online sexual activity.³¹ The Internet Assessment Quickscreen (IA-Q) is another tool for performing a basic overview assessment of common issues for cybersex users. The interview has two sections to measure the extent of an individual's knowledge of the internet and online sexual behaviors and to address social, sexual, and psychological aspects of cyber sexual behavior.²⁷

Cyber-relationship addiction

The internet also facilitates virtual social relationships through social networking sites (SNSs). They enable people to create individual public profiles, interact with real-life friends, and meet other people based on their interests.²¹ The usage patterns of SNS from both consumer and empirical research showed an increase over the last few years.³² Much of this occurs when rates of migration increase and technology develops. This phenomenon is easily understood in terms of the basic desire to be part of

a community or to be well known as a social human being. On the other hand, this condition leads into decreased social interaction in real life compensated by more social networking through the internet to fulfil the basic desire. Many organizational employers claim that social networking addiction is a cause for concern, especially among young people. Turel and Serenko summarized three theoretical perspectives about the emergence of social networks. The first one is a cognitive behavioral model that emphasizes abnormal social networking which arises from maladaptive cognition and is strengthened by various environmental factors. The second model is the social skill model, wherein social network participation occurs because of a lack of self-presentation skills and the feel of comfort in virtual communication compared with direct interactions. The third model is socio-cognitive, due to the expectation of positive outcomes combined with internet self-efficacy and deficient internet self-regulation. Based on these three models, some factors such as stress, loneliness, or depression play an important role in changes behavior from normal to problematic social networking. However, in actuality, each model can lead to compulsive and/or addictive social networking behavior.³³

Social interaction through the internet differs from interaction in real life. It provides anonymity and allows more time to create and edit verbal messages to make the desired impression.²¹ In individuals who have severe social anxiety disorder, interaction through the internet provides more than just comfort. It can actually lead to problematic internet use (PIU), where psychosocial and/or interpersonal difficulties (i.e., loneliness, social anxiety, low social skill, and introversion) could impair users' lives. Even though social networking addiction is still a debatable topic, addiction-like symptoms as a consequence of excessive use can be seen clearly in a minority group.²¹

Net compulsions

One of the most popular net compulsions is gambling. It is a popular activity across many cultures.²⁷ In DSM-5, the disorder is included in the chapter on substance use disorders because of similar characters such as consistently high rates of comorbidity, the presentation of symptoms, and genetic physiological overlap.²³ A gambling disorder usually begins in adolescence or early adulthood, with males tending

to start at an earlier age. Internet usage has made the introduction of remote gambling (e.g., internet gambling, mobile phone gambling, interactive television gambling) and access to gambling all over the world easier. A study also reported that it induces the largest cultural shift in the world and leads to problematic gambling behavior. The best-known internet gambling sites are online casinos, cards, sport pools, and online lottery.²⁷ Griffith has argued that gambling addiction is different from internet addiction.³⁴ In gambling addiction, the internet is only a way to engage in their behavior. On the other hand, the internet provides interactivity and allows them the feeling of animosity to facilitate social gamblers. It could induce more excessive gambling behavior than they would have done offline. Furthermore, easy access will increase the frequency and possibility of addiction.²⁷

Information overload

Information overload refers to individuals who become addicted to using search engines and the like to collect information. Web-surfing addiction is perhaps the least straightforward and can be inseparable from other subtypes (e.g., cyber sexual addiction and the collection of pornographic images). The World Wide Web has created new kind of compulsive behavior that involves excessive web surfing and database searches. These individuals spend a disproportionate amount of time searching, collecting, and organizing information.³⁵ This addiction is also included in generalized pathological internet use (PIU), referring to a more global set of internet behaviors that could not exist outside the realm of the internet, such as chat rooms, surfing the web, or email. Generalized PIU involves spending abnormal amounts of time on the internet, either wasting time with no directive purpose or spending vast amounts of time in chat rooms. These individuals may check their email several times a day and/or spend much of the day replying to bulletin boards. The cognitive behavioral model proposes that maladaptive cognitions are critical to the development of generalized pathological internet use behaviors. Individuals with generalized PIU use the internet to put off their responsibilities, and this wasted time results in significant problems with daily functioning, as they are not able to accomplish their responsibilities. Examples of maladaptive cognition include self-doubt, low self-efficacy, and

negative self-appraisals. Behaviors that occur along with generalized pathological internet use cognition include compulsive internet use that leads to negative outcomes at work, at school, or in personal relationships, denying or lying about internet use, and using the internet to escape from one's problems.³⁶

Computer addiction (pathological computer game playing)

There are two types of video games: online and offline video games. They have some different characteristics. Offline games are usually played alone and have a definite starting and finishing point. The goals of the games can usually be achieved by the players themselves. In contrast, in online games, players can communicate with one another in real time as well as cooperating or competing. Some goals in online games can be achieved alone or together with other players who are working in groups. Online gaming participation itself has been increasing since its first appearance in the 1990s because online games can be accessed easily by every culture, age, and gender.^{21,25}

Online gamers can spend more time gaming than offline gamers because of the satisfying and pleasant feelings they experience. These feelings also contribute to the frequency and duration of online gaming. Moreover, online gaming has developed significantly nowadays. In their first appearance, online games were text-based virtual worlds. However, in recent decades, there is a complex graphical virtual world, known as massively multiplayer online games. The massively component can involve many players to be present in the same virtual game world at any given moment through an internet connection.²¹

Young's internet addiction approach is the best known and most commonly used. It has developed into pathological gambling criteria in DSM-IV. Internet gaming disorder has also been included in DSM-5, section III.²³ Losing control and inability to reduce the time spent playing, followed by problems in real life are some criteria for determining internet addiction.

There are six dimensions described in the definition of online gaming addiction: preoccupation, overuse, immersion, social isolation, interpersonal conflicts, and withdrawal.⁸ The activity induces compulsive behavior, so the person increases the intensity of their playing to obtain gratification. If the feelings are not satisfied, the inner tension may increase and turn

Table 1. Prevention programs for internet addiction

Category	Program
Rules and regulation at home	Restrict the duration of use of screen entertainment
	18–24-month-old children: avoid using screen media
	Preschoolers: no more than 1 hour per day
	Elementary school children and teens: not using online media to replace other important activities:
	1 hour of daily exercise
	Family meals
	A full night of sleep
	Avoid spending more than 3 hours on online games applications because it leads to emotional problems, externalizing disorder, prosocial behavior issues, and decreased life satisfaction in children
	It is not recommended that gadgets or internet access be placed in children's rooms
	Not using gadgets or playing online games in the half hour before sleeping
	Restricting the duration and content of internet access is a good protective measure against internet addiction
Adult supervision of children's media use	Before playing an online game and accessing the internet, make an agreement about the duration of usage
	Teach children "how to use gadgets and how to stop using them"
	Provide time for evaluation and monitoring of gadget and internet usage between children and parents
	Discourage screen media and gadget exposure for children under 18 months
The role of schools and educators in preventing internet addiction	Schools should provide education and/or seminars: "using internet wisely", "problems of internet addiction" to teachers, students, and parents
	Schools are a good place for early screening of internet addiction symptoms
Improvement of parenting skills	Improve parent-child communication
	Increase the amount of time parents and children spend together
	Parents should be aware of their children's online activities, so internet usage can be adjusted based on knowledge and necessity
	Improvement of parental mental health
	Teach parents how to guide their children to divert attention to beneficial activities other than the internet
Government regulations	Age restriction on internet access
	Distance between internet cafés and elementary or middle schools should be addressed. The distance allowed is within 200 meters.
	The business hours of internet cafés should be adjusted
	Policies and regulations for online gambling companies should be implemented to minimize the harm associated with their activities

into aggressive behavior. Under these conditions, they could ignore their usual obligations and social interactions. Somatic symptoms may be experienced, such as eating or sleeping problems, gaining or losing weight, dry or strained eyes, backaches, carpal tunnel syndrome, repetitive strain injuries, and general fatigue or exhaustion.²¹

Prevention of internet addiction

A prevention program for internet addiction is important because of the possibility of many negative effects of this dependency, and it needs support from various parties. Prevention programs for internet addiction can be seen in Table 1. In conclusion, the internet as a modern technology has

made life so much easier because of the simplicity obtained from it. On the other hand, there are rising problems concerning pathological issues because of this technology; they are collectively termed internet addiction. This especially affects adolescents in this era where the internet has been a part of their life since they were born. The concept of internet addiction originates from behavioral addiction. A neuroimaging study from behavior addiction showed a connection between changes in brain structure and brain function related to reward, emotion, executive function, attention, decision making, and cognitive control, which is the same as in substance addiction. There are five subtypes of internet addiction identified by Young: cybersex addiction, cyber-relationships, net compulsion, information overload, and computer addiction. Each subtype has almost the same symptoms as substance addiction, such as salience, tolerance, mood modification, loss of control, withdrawal, denial and concealment, and relapse, but the exact diagnostic criteria are still debatable. The subtypes of addiction other than computer addiction exist in clinical practice, but the only subtype included in DSM-5 is computer addiction, which called internet gaming disorder, but further study is needed in terms of diagnostic criteria to determine the best treatment.

Conflicts of Interest

The authors affirm no conflict of interest in this study.

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