Exploring the Interplay Between Internet Addiction Disorder, Internet Gaming Disorder, and Excessive Daytime Sleepiness.

Pranav Chepyala

Introduction:
While the phenomenon of internet addiction is well known, there has not been a broadly defined consensus as to what this ailment entails. A rough approximation of the term from the Victorian State Government (which is a state-level authority for the Australian state of Victoria, Australia) stated that internet addiction disorder (IAD) was essentially when a person has a compulsive need to spend a “great deal of time” on the internet. They go on to elaborate that this addiction/compulsion reaches the extent of impacting one’s functioning, including relationships, health, and work (The Victoria State Government (n.d.)). Although this statement is very vague and broad, it also encompasses many general statements that apply to nearly all addictions while also relating to obsessive-compulsive disorder (OCD) and other mental health issues. Many of the sources associated with this project came directly from PubMed Central through the National Library of Medicine (NLM), a part of the National Institute of Health (NIH) and the U.S. Department of Health and Human Services. The current research suggests two disorders that are purported to be related to IAD: internet gaming disorder (IGD) and excessive daytime sleepiness (EDS), otherwise known as hypersomnia. IGD is a mental health condition where a person becomes so obsessed with online gaming that it interferes with their daily life. People with IGD may neglect their work, school, relationships, and other essential activities to play. They may also experience withdrawal symptoms when they are not able to game (Mohammad et al., S. L. (2023)). IGD, as stated by the *DSM-V-TR (American Psychiatric Association, 2022)*, is indicated via the support of five out of nine possible core symptoms, including preoccupation, withdrawal, tolerance, loss of control, surrender from other hobbies, continuation despite harm, fraud/deceit in regards to usage, escapism, and relationship harm. EDS/hypersomnia is a sleep disorder that causes people to feel excessively sleepy during the day. People with hypersomnia may fall asleep at inappropriate times, such as while driving or working. They may also have difficulty staying awake during the day when they usually do not feel such symptoms under normal conditions. While EDS/hypersomnia carries traits similar to narcolepsy, they are independent yet correlated disorders. There is a strong correlation between the prevalence of IAD and EDS in minors/adolescents, according to a South Korean study. The authors of the study went on to state that the adolescent population they tested had a higher prevalence of EDS given that they came from male populations, alcohol drinkers, and self-selected as being of “poor” health condition (Choi et al., (2009)). Interestingly, smoking can cause a phenomenon known as “sleep fragmentation”(Wetter et al., (1994)) alongside causing EDS symptoms (Rhee et al., (2021)) but cessation from/quitting smoking can also lead to EDS (Prosise et al., (1994)).

This complexity necessitates a detailed exploration of how these disorders manifest and intersect.

Objectives:

- Is there a significant relationship between the disorders IAD, IGD, and EDS, and if so, what are they, and how do they manifest?
    - What are the treatments, if any, against IAD, IGD, and EDS?
    - What populations are most at risk for developing IAD/IGD?
- Is there a relationship between neurophysiological disorders and the prevalence of IAD/IGD?
- What are potential complications or comorbidities associated with the aforementioned disorders?

Methods:

This literature review was conducted using the databases *PsycInfo* and *PubMed.* The following search terms were entered concerning IAD, IGD, and EDS. Keywords included 'Internet,' 'gaming,' 'excessive,' 'sleepiness,' 'problematic,' 'compulsive,' and 'addictive.' Studies were selected based on the following parameters. The above databases were searched in June, July, August, September, and October 2023. After thoroughly examining the articles' titles and abstracts, the articles that did not meet the inclusion criteria were excluded. Data regarding study outcomes was organized in a manner that was most conducive to the literature review format.

This literature review goes over various sources that discuss the possible relationships between IAD, IGD, and EDS. This review sources its data from public databases and search engines such as *PubMed*, *PsycInfo*, and Google Scholar.

Results & Discussion:

As a preface, some studies use different acronyms or shorthands, such as internet addiction (IA), as opposed to the definition of internet addiction disorder (IAD). These terms usually relate to the same thing, but I will use the terms used in the original study to avoid misconstruing arguments and conclusions.

Internet addiction disorder refers to a behavioral disorder that arises from excessive and compulsive use of various modern communication and engagement methods available through the Internet (Levounis et al., (2022)). These methods include but are not limited to social media, online gaming, online shopping, and online pornography (Levounis et al., (2022)). This addiction is driven by the frequent use of technologies that utilize behavioral techniques to encourage and reward continuous engagement because their revenue is driven by said engagement (Levounis et al., (2022)).

The term "internet addiction disorder" (IAD) is considered antiquated. It has been largely replaced by more specific terms such as internet gaming disorder (IGD), social media addiction (SMA), online shopping addiction (OSA), and online porn addiction (OPA) (Levounis et al., (2022)). Each of these specific addictions represents a distinct pattern of compulsive behavior related to the respective technology or platform. Most of the disorders mentioned above follow similar chemical pathways in the brain, but each has differing underlying causes. IGD applies explicitly to an overuse/dependency on internet gaming as a means to waste time, whereas SMA is derived from affirmations and socialization. OSA and OPA are both specifically caused by elevated dopamine release but are caused by differing underlying factors.

Individuals with internet addiction may experience irresistible urges to engage with these technologies, leading to excessive time spent online and neglect of other vital aspects of life. The overutilization of modern technologies can result in various adverse consequences, including social, emotional, and economic impairment or distress (Levounis et al., (2022)). These are common side effects found in other drug-related addictions, and it makes sense in this context because routine overuse/misuse can easily take up time that is required to maintain and support social, emotional, and economic aspects of life.

Research in the field of internet addiction is rapidly evolving, and promising therapeutic and psychopharmacologic treatments are being explored. For example, cognitive therapies have shown efficacy in treating technological addictions like IGD, SMA, OSA, and online porn addiction.

As society becomes increasingly dependent on addictive technologies, the prevalence of technological addictions is likely to rise. However, with the advancement of research and literature, there is hope for developing more effective treatment options to address these modern-day behavioral disorders (Levounis et al., (2022)).

Despite the (word that means vague) of the term IAD, other sources define it as a “compulsive need to spend a great deal of time on the internet to the point where relationships suffer” (The Victoria State Government (n.d.)). This base definition shows that the vague nature and lack of

verbiage often found in concrete operational definitions is why the term IAD is often neglected for other, more directly applicable terms. For this paper, the term IAD will still be used for its comprehensibility and clarity to the general public.

One review asserts that IAD, despite its omission from the *DSM-V-TR*, can be described as a "human-machine interaction" or an addiction that utilizes similar mediums as that of traditional addiction but with a mechanical component as well. The review goes on to highlight the potential negative impact of IA on adolescents' emotional-behavioral functioning and the risks it poses to their mental health. Excessive internet use can lead to social withdrawal and hinder genuine real-life sociability, possibly resembling the hikikomori phenomenon (i.e., extreme withdrawal to one's room) that originates in Japan (Teo et al., (2010)).

The aforementioned hikikomori phenomenon is also highly intertwined with IAD as many people of adolescent age have extreme agoraphobia and 'withdrawal neurosis' (Cerniglia et al., (2017)). Adolescence is also considered a critical stage for IA vulnerability due to neurobiological plasticity, allowing for adaptation to physical and emotional changes and the development of independence (Teo et al., (2010)).

Another Italian paper reviewed the totality of IAD and its usage in studies. The paper discusses the concept of IAD and the challenges in formulating precise diagnostic criteria for this condition. The study highlights that the rapid evolution of internet use and its integration into various aspects of daily life make it difficult to determine what constitutes pathological internet use. The researchers involved in this study have proposed different criteria for IAD, including withdrawal, tolerance, preoccupation, and negative consequences, but there is a lack of consensus on defining the disorder. Moreover, neuroscientific evidence on IAD is still limited and inconclusive. Some researchers advocate for a specific IAD diagnosis, while others propose alternative models such as internet-related psychopathology (IRP), considering various internet-related activities as separate pathologies. The authors suggest the need for a more comprehensive and integrated model to understand internet-related behaviors (Musetti et al., (2016)). Rather than viewing internet addiction as a single entity, the authors suggest considering internet behaviors as a collection of independent disorders with the commonality of using the internet as a medium. This approach would account for internet use's diverse and complex nature in contemporary society (Musetti et al., (2016)). This study also discusses how IAD criteria like withdrawal, preoccupation, and adverse consequences are all probable criteria for IAD while they also match similar identifiers found in the hikikomori phenomenon (Musetti et al., (2016)). Overall, the study emphasizes the complexity of IAD and the necessity for further research to develop a comprehensive model that addresses the intricate relationship between internet use and various

behavioral patterns. As internet technology shapes human behavior, a nuanced understanding of internet-related disorders becomes crucial for accurate diagnosis and effective treatment.

"In a study conducted in China, researchers explored the correlation between problematic digital media usage (PDMU) and attention-deficit/hyperactivity disorder (ADHD). It is important to note that the original study measured ADHD and PDMU, recognizing the intrinsic relationship between these terms. Due to the overlap between PDMU and internet addiction disorder (IAD), we will use IAD as a surrogate term in this discussion. The interconnectedness between PDMU, IAD, and ADHD justifies this study's inclusion in the review. To strengthen this argument, defining IAD and highlighting the significant overlap between PDMU and IAD is essential, as established in the original study and supported by existing literature. In this research, the objective was to investigate the impact of digital media usage on children and adolescents diagnosed with ADHD, particularly during the COVID-19 pandemic. The study involved 192 participants aged 8-16 years, all diagnosed with ADHD. The comparison in this study specifically focused on individuals demonstrating PDMU, as determined by self-rating questionnaires related to mobile phone use and internet addiction, and those who did not exhibit PDMU. This comparative analysis encompassed various dimensions, including ADHD symptoms, emotional well-being, executive function (EF), life events, learning motivation, and family environment."

The results indicated that the group diagnosed with both ADHD and PDMU demonstrated more severe symptoms of inattention, oppositional defiant behavior, and emotional problems. This finding is reinforced by existing evidence that establishes a clear and direct link between PDMU and ADHD symptoms, executive functioning impairment, and behavioral issues. In essence, the individuals in the group diagnosed with both PDMU and ADHD exhibited notably exacerbated symptoms and challenges compared to those with either condition alone. They also reported higher levels of anxiety and depression, experienced more significant stress from life events, had lower learning motivation, and more negatively affected family cohesion. Additionally, they spent significantly more time on video games and social media and less time on physical exercise compared to the ADHD group without PDMU.

The findings suggest that children with ADHD who also have PDMU face more significant challenges in various aspects of their lives, including mental health, learning, and family relationships. The study highlights the importance of monitoring and supervising digital media usage, particularly video games and social media, and promoting physical exercise (as an alternative to digital media) as part of managing aggravated ADHD symptoms and associated problems related to PDMU and, by proxy, IAD (Shuai et al., (2021)). A future study would greatly benefit from adding more controls to see if the correlations made were, in fact, simply causal.

While ADHD has links to PDMU, it is crucial to note that various neurodevelopmental disorders are being explored in the context of internet addiction. Autism spectrum disorder (ASD), a neurodevelopmental disorder characterized by difficulties with social interaction and communication, is another area of interest in this ongoing research. Understanding the relationship between ASD and IAD sheds light on the complex interplay between neurological factors and excessive internet use. In a noteworthy study conducted in Japan, researchers went over the feasibility of testing adolescents on the autism spectrum for probable internet addiction via a shortened test. The study investigated the clinical usefulness of a short version of the Internet Addiction Test (s-IAT) for screening Internet addiction (IA) among adolescents with ASD. The s-IAT is a shorter version of the Internet Addiction Test (IAT), a self-rating scale widely used to assess IA and designed by Kimberly Young (Young, 1998)). The study involved 104 adolescents with ASD who were diagnosed through face-to-face clinical interviews. The results showed that the s-IAT was as effective as the full IAT in screening for IA among ASD adolescents despite a limited sample size. The test had a moderate discrimination accuracy and was roughly as good at distinguishing between those with IAD and those that did not have IAD. The researchers used a CO35 (Cut-Off 35) as opposed to a CO37 (Cut-Off 37) because it both increased the test reliability based on results from a Receiver Operating Characteristic (ROC) analysis. They compared this with the full IAT's CO70 and noted that it may not be suitable for IA screenings compared to the s-IAT. The findings suggest that the s-IAT may be a valuable tool for early detection and intervention in individuals with ASD who are at risk of developing severe IA. Identifying problematic internet use early on is essential to prevent its negative consequences on personal, social, educational, and occupational functioning. The s-IAT can help clinicians and researchers identify individuals who may require further assessment and support to address internet addiction disorder (Tateno et al., (2023)). It is important to note that both ASD and ADHD are widely defined as neurodevelopmental disorders and are, writ large, some of the most common neurodevelopmental disorders (Hours, C., Recasens, C., & Baleyte, J. (2022)). The CDC, via the usage of datasets in 2016-2019, found that approximately six million or 9.8% of all people aged 3-17 were officially diagnosed with ADHD (Centers for Disease Control and Prevention (2023). The CDC also studied child populations from 2000 to 2020, studying children born from 1992 to 2012. The prevalence of ASD continues to increase from 1 in 150 in the 2000 study to a recent high of 1 in 36 in the 2020 study (Centers for Disease Control and Prevention (2023)). Therefore, additional research in this domain is essential for understanding the relationships between these disorders in order to support the growing number of youth with these disorders. Such studies are instrumental in developing specific interventions and practical strategies to address IAD's impact on affected individuals and society.

Several studies mentioned the link between IAD and IGD. One review attempted to find similarities or differences between the disorders via the usage of electroencephalography (EEG) (Burleigh et al., (2020)). This review reveals distinct neurophysiological features associated with these disorders. The review included ten studies investigating the resting-state EEG activity in individuals with IGD and IAD. The findings for IGD suggest a neurophysiological distinction between it and IAD. IGD correlated with a raised delta and theta activity alongside decreased beta activity, thus indicating altered brain activity in these ranges. The findings for IAD revealed a raised gamma activity while also showing a decrease in activity related to beta and delta waves. Gamma waves are related to concentration; beta waves signal anxiety, activity, and relaxation; and delta waves are associated with sleep. Doe IGD, these results seem to suggest a state wherein anxiety fades away as feelings of concentration and pseudo-sleep are reached. For IAD, on the other hand, an increase in gamma waves signals increased concentration, while the decrease in beta and delta waves signals a decrease in 'tiredness' and anxiety symptoms (Elsevier (2023, April 4)). It is worth noting that the neurophysiological patterns (brain wave types and frequency) observed in IGD and IAD share some similarities with those found in substance use disorders.

Examining EEG patterns in alcohol and internet addiction reveals nuanced distinctions. In alcohol addiction, increased beta activity suggests enhanced cortical excitability due to GABAa receptor dysfunction and excitotoxicity, leading to cortical hyperexcitability. Conversely, internet addiction presents with decreased beta power and heightened gamma activity during resting states, indicating impaired attentional processes and inefficient neural activity. The divergent EEG alterations underscore unique neurobiological mechanisms in these addictions, emphasizing the need for tailored interventions. Understanding these specific neural signatures can guide precise therapeutic strategies, enhancing treatment efficacy for individuals grappling with addiction (Coutin-Churchman et al., (2006))(Choi et al., (2013)). However, the results indicate that the disorders (IAD & IGD) had distinct neurological markers. The review highlights the importance of distinguishing between IGD and IAD as separate and unique constructs despite some overlapping features. These distinct neurophysiological markers may aid in improving diagnosis and intervention strategies for individuals with IGD and IAD.

Regarding the relationship between IAD and IGD, the review supports that they represent separate and distinguishable entities. While both disorders involve problematic internet use, the neurophysiological findings suggest different underlying mechanisms and characteristics. Each disorder has distinct neurophysiological markers that provide evidence for the unique nature of IGD and IAD and lend credence to the possibility of classifying them as separate behavioral addictions. The authors of the study went on to recognize "IGD" as a condition that would require further study and investigation to better diagnose and define it (Burleigh et al., (2020)).

In addition to exploring the interconnections between ADHD, PDMU, and related disorders, it is vital to understand the effective treatments available for specific digital media-related conditions. In one study, authors conducted a comparative analysis of IAD and IGD and potential treatments. Their research aimed to evaluate the efficacy of various treatments for IGD through a comprehensive meta-analysis of randomized controlled trials (RCTs) and meta-regression.

The study analyzed 124 research studies involving 5601 children and young adults with IA and IGD, revealing compelling results. The findings suggested combining pharmacotherapy with cognitive behavioral therapy (CBT) or multi-level counseling (MLC) proved highly effective in treating IA/IGD. The researchers used 'measurement of time spent online' and 'severity of IA symptoms scale' as their predictor variables. It is essential to highlight, however, that patients with comorbid depression experienced the worst outcomes overall. These results emphasize the significance of tailored therapeutic strategies, indicating that pharmacotherapy combined with CBT or MLC might offer promising solutions for youth struggling with gaming disorders.

IGD is officially recognized as a temporary disorder by the American Psychiatric Association (APA) in the fifth revision of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-V-TR)* and also included in the International Classification of Diseases (ICD-11). According to the *DSM-V-TR*, IGD is characterized by the presence of at least five core symptoms out of nine exhibited over 12 months. The diagnostic criteria for IGD include symptoms such as preoccupation with video games, withdrawal symptoms when not playing, increased time spent gaming, failed attempts to control gaming, loss of interest in other activities, continuing gaming despite problems, deception about gaming habits, use of games to cope with negative emotions, and significant negative consequences in relationships, work, or education due to gaming. This disorder is labeled as mild, moderate, or severe depending on how many diagnostic criteria are met (Nasution, F. A., Effendy, E., & Amin, M. M. (2019)).

The inclusion of gaming disorder in the 11th edition of the ICD raised concerns about its prevalence- a prevalence that has shown substantial variation across different studies and regions. To address this, a review analyzed data from 53 studies conducted between 2009 and 2019, involving over 226,000 participants from 17 countries. The review employed meta-analysis to determine a global prevalence rate of gaming disorder, initially at 3.05%, which decreased to 1.96% when accounting for more rigorous study criteria (Stevens et al., (2021)). Variability in estimates was significant, with the choice of assessment tool explaining many differences. Participants' age, gender, sample size, and study region also played a role. Notably, prevalence was higher in adolescents and males with specific assessment tools. The findings suggest that while gaming disorder's prevalence is similar to specific disorders, methodological

aspects, especially measurement and sampling techniques, could be inflating its reported rates (Stevens et al., (2021)).

One review provided an overview of research concerning the neurological aspects of IGD, which is a direct way to examine how digital technology and the internet affect the brain. Neuroimaging studies indicate that IGD shares similar brain changes with other addictions. These include activation in reward-related brain areas, observed through cue exposure and craving studies, and involvement of dopamine-mediated reward mechanisms. Additionally, impulse control areas show reduced activity, leading to impaired decision-making, and there is a decrease in functional connectivity within brain networks related to cognitive control, executive functioning, motivation, and reward. Structural changes, such as gray-matter volume and white-matter density reductions, are also present. A reduction in gray matter via atrophy (or nerve cell death) can lead to loss of memory/symptoms of dementia, cognitive impairments, and motor impairments, specifically fine motor skills (a). Gray-matter reductions and excessive damage can also lead to symptoms found in patients with Alzheimer's and Parkinson's (b). A reduction in white-matter density is also known to be associated with neurodegeneration and impairment in cognitive and functional impairments (c). The review suggests that excessive screen use, particularly gaming, affects various brain regions involved in cognitive, motor, and sensory functions, distinct from other addictions. Notably, this comprehensive summary focuses on how addictive internet use impacts the brain in adolescents and young adults (Weinstein, A., & Lejoyeux, M. (2020)).

As mentioned before, adolescents are the population group most susceptible to excessive internet and online game usage. A study focused on the characteristics of young gamers who are at risk of developing IGD based on overall usage. The research, conducted in Slovenia with 1071 participants from eighth-grade primary schools, used psychometric testing to assess IGD risk levels and compared "high-risk gamers," "low-risk gamers," and "non-gamers" in terms of their free-time activities, self-control, and parent-child relationships. About 4.7% of Slovenian adolescents were found to be at high risk for IGD, primarily males with preferences for screen-based activities. High-risk gamers exhibited lower self-control and weaker parent-child understanding than low-risk gamers, but life satisfaction and mental health did not vary significantly. The study identified four key predictors of IGD vulnerability: being male, frequently engaging in gaming during leisure time, attending music school or a choir, and having lower self-control. The findings emphasize the need for public health interventions targeting adolescents at risk of IGD due to their susceptibility to excessive gaming behaviors (Macur et al., (2021)).

This subsequent study showcased how problematic internet abuse, which can lead to uncontrollable and harmful effects, has gained attention in psychiatric literature. The paper goes

on to mention that the internet offers valuable opportunities for education and support, yet they go on to reiterate that excessive use poses potential risks. They use the statistic that over the past 15 years, various repetitive behaviors have been suggested as possibly linked to OCD, forming the category of obsessive-compulsive spectrum disorders (OCDS). These types of disorders can often lead to comorbidities as one similar type of disorder can be a catalyst that causes afflictants to suffer from more OCDS or ICDs (like body dysmorphic disorder, anorexia nervosa, and impulse control disorders). Many of these behaviors are associated with comorbid OCDS and may respond positively to selective serotonin reuptake inhibitors (SSRIs). However, as with OCD, some cases may not fully respond to SSRIs alone, requiring augmentation strategies. The study ends by presenting a case study of problematic internet use that responded to a combination of SSRI and quetiapine treatment (Atmaca, M. (2007)).

Another systematic review aimed to evaluate the quality of treatment literature for gaming disorders before the inclusion of internet gaming disorder in the *DSM-5* and 'Gaming disorder' in the draft ICD-11. This review analyzed the reporting quality of 30 treatment studies conducted from 2007 to 2016, using the 2010 CONSORT statement as a reference. The findings echoed previous criticisms of these trials, including inconsistencies in defining, diagnosing, and measuring disordered use; a lack of randomization, blinding, and controls; and insufficient information on recruitment and sample characteristics. While CBT had a more substantial evidence base than other treatments, making definitive statements about its benefits remained challenging. The study design quality has not improved over the past decade, emphasizing the need for greater consistency and standardization in this field. Ongoing international efforts to understand gaming disorder's core psychopathology are essential for developing effective treatment practices (King et al., (2017)).

Another study is particularly noteworthy as it addresses the issue of internet gaming disorder (IGD) among Indonesian medical students, a topic that has seen limited prior research attention. While internet addiction has been explored in medical students, understanding of IGD specifically is lacking. This gap in research highlights the significance of the study's findings, shedding light on a crucial area that warrants further investigation. The study's goal was to determine the prevalence of IGD in this context and investigate its correlations with temperament and psychopathology. Conducted between August and September 2019, the research involved 639 private and public university participants using total and convenience sampling. Results showed an IGD prevalence rate of 2.03%, with an average age of 20.23 years and a weekly gaming duration of 19.0 hours. Most participants played games on their mobile phones, and those with IGD reported various psychopathologies except phobic anxiety. The study found associations between IGD and factors like gender, gaming duration, gaming community involvement, and multiple psychopathology domains. The results stated that twice as

many male students experienced IGD when compared to female students. Notably, this is consistent with previous studies. The male students in the study also showed signs of amplified connectivity in their mesocorticolimbic pathway when playing video games than that of female participants. The mesocorticolimbic pathway is known for its pivotal role in reward assessment, behavior motivation, and cognitive regulation through dopaminergic modulation (controlling dopamine flow and, by proxy, electrical communication between neurons). Logistic regression revealed a correlation between IGD and weekly gaming hours of 20 or more hours. The findings highlight the similarity of IGD prevalence among Indonesian medical students and other Asian populations, with weekly gaming duration acting as a predisposing factor, and suggest the need for strategies integrated into medical curricula to support individuals with such tendencies (Siste et al., (2021)).

Another study examines the prevalence and connections of *DSM-5* diagnosis of IGD with excessive daytime sleepiness, daytime dysfunction, mental health conditions, and overall health among young adults residing in on-campus student housing at an American university. Over two academic years (2007 and 2015), phone interviews were conducted with a random sample of 2,984 students (undergraduate and graduate). IGD was identified when students spent ≥15 hours weekly on electronic devices for leisure (39.4% of students) and showed ≥5 addiction-related symptoms as per the *DSM-V*; this applied to 5.3% of the sample. Comparatively, those with IGD exhibited higher rates of suicidal thoughts, suicide attempts, major depressive disorder, and social anxiety disorder than those without the disorder. In more comprehensive analyses, IGD was linked to poor sleep, excessive fatigue, fewer close friends, depressive mood, bipolar disorder, social anxiety disorder, and lower health status. The research underscores the significant prevalence of IGD among students, impacting around one in 20 individuals. Moreover, IGD was associated with various sleep, mental health, and health factors that could affect functioning and academic performance (Ohayon, M. M., & Roberts, L. (2021)).

An additional study addressed IGD, where excessive internet gaming impacts daily life, investigating how individualistic and collectivistic tendencies relate to IGD symptoms. Using the Internet Gaming Disorder Scale – Short Form (IGDS9-SF) and the Individualism & Collectivism Scale (ICS), the online survey involved 1,032 participants with gaming experience. Latent Class Analysis revealed two gamer profiles: Collectivism Aversive (CA; 11%) and Collectivism Neutral (CN; 89%). CA gamers exhibited significantly higher overall IGD symptoms, including preoccupation, withdrawal, tolerance, relapse, deception, and functional impairment, compared to CN gamers. Notably, individualism-collectivism orientation influenced IGD presentation; less collectivistic individuals showed more severe IGD symptoms. This highlights the need for tailored prevention and intervention strategies, considering the impact of

individualism-collectivism tendencies on gamers' mental health and gaming patterns (Stavropoulos et al., (2021)).

From 2007 to 2015, prevalence estimates for excessive internet use in adolescents varied widely, ranging from 0.7% to 9.4% in the United States and 1.2% to 18.7% in Europe (Ohayon, M. M., & Roberts, L. (2021)). A recent study done on the campus of Stanford University has concluded that excessive internet use has been linked to reduced sleep duration, delayed bedtime, increased daytime sleepiness, major depressive disorders, anxiety, and even suicide (Ohayon, M. M., & Roberts, L. (2021)). Other studies on this topic often lack controls for other factors influencing these associations, making it challenging to establish a clear cause-and-effect relationship. This study, however, assessed IGD prevalence in a large sample of university students and explored its associations with sleep and psychiatric and health factors based on the *DSM-5* criteria for diagnosis (Ohayon, M. M., & Roberts, L. (2021)).

EDS is a common condition associated with significant health implications. EDS can be a common side-effect of IGD. It can also result from various factors such as inadequate sleep, sleep-related breathing problems, circadian rhythm disruptions, and central hypersomnolence disorders like narcolepsy (Gandhi et al., (2021)). It can also be a symptom of underlying medical or psychiatric issues. A study on the Mayo Clinic proceedings assessed EDS. It recommended a comprehensive evaluation for those afflicted, including a detailed sleep, medical, and psychiatric history, clinical examinations, sleep monitoring through actigraphy and polysomnography, multiple sleep latency testing for objective sleepiness, and measuring cerebrospinal fluid hypocretin-1 levels.

There are many tests that can be used to diagnose underlying conditions related to EDS, like actigraphy, polysomnography, and multiple sleep latency. The treatment for EDS depends on the cause; medications like modafinil and behavioral interventions are used as pharmacological treatments for central disorders of hypersomnolence. When EDS is secondary to other conditions, treatment should target the root cause. For this reason, secondary EDS is better treated by addressing primary disorders via CBT (Levounis et al., (2022)).

Excessive daytime sleepiness is prevalent among adolescents, impacting various aspects of their lives, including school performance, relationships, extracurricular activities, health, and even driving safety. When dealing with adolescents reporting excessive daytime sleepiness, a comprehensive clinical assessment involving clinical interviews, physical examinations, sleep diaries, specialized questionnaires, and potential confirmatory tests is crucial. This condition can arise from diverse factors, such as sleep deprivation, poor sleep habits, insomnia, circadian

rhythm disruptions, underlying medical conditions, mental health disorders, sleep-related movement or respiratory issues, parasomnias, hypersomnia disorders, or substance use. Given this array of potential causes, it is essential for healthcare professionals to implement tailored therapeutic strategies to effectively manage excessive daytime sleepiness in adolescents, mitigating its adverse consequences. This review aims to guide healthcare providers in addressing the primary causes of excessive daytime sleepiness in this population (Hein et al., (2020)).

An Ethiopian-based institution conducted a cross-sectional study among 383 University of Gondar (UoG) Medical and Health Science students to investigate excessive daytime sleepiness (EDS) and its predictors in this population, as no prior research had been conducted on EDS in Ethiopia. The study here defined EDS to be sleeping or experiencing symptoms of tiredness/loss of mental alertness despite sleeping the estimated average of 7-9 hours per night (Dagnew, B., Andualem, Z., & Dagne, H. (2020)). The study found that EDS was prevalent among 31.07% of the participants. Factors associated with an increased risk of EDS included reporting night sleep behavior disorders and experiencing depression, with odds ratios of 1.83 and 1.84, respectively. These findings highlight the high occurrence of EDS among university students and emphasize the importance of implementing preventive measures such as counseling to address depression and night sleep behavior disorders (Dagnew, B., Andualem, Z., & Dagne, H. (2020)). IAD and IGD are both potential causes of depression and night sleep disorders as they both are, as stated before, potential triggers for major depressive disorder (MPD) while also having the capability to cause strain on social, emotional, and financial impairments as stated before(Levounis et al., (2022)). The use of CBT to treat IAD is known as “CBT-IA” and has been used in at least six studies, all testing the efficacy and validation of CBT usage in this context (Levounis et al., (2022)). Furthermore, there is limited evidence to support the claim that escitalopram may be an effective treatment for IAD, but the evidence is lacking (Levounis et al., (2022)). Further research, mainly qualitative studies, is recommended to explore additional factors contributing to EDS in this context.

This study aimed to investigate the connection between excessive Internet use and excessive daytime sleepiness (EDS) among high school students in South Korea. The researchers surveyed 2,336 students and used Young's Internet addiction test to assess Internet addiction severity. The findings revealed that a significant proportion of both boys and girls were classified as addicted or possibly addicted to the Internet. Additionally, the prevalence of EDS was notably higher in those addicted versus those who were not. Internet addicts were more likely to be boys, consume alcohol, and perceive their health as poor, but there was no significant link between smoking and Internet addiction. Furthermore, the study identified a higher prevalence of various sleep-related problems such as insomnia, snoring, apnea, teeth grinding, and

nightmares among Internet addicts, followed by possible addicts and non-addicts. After adjusting for several factors, including duration of Internet use, sleep duration, age, gender, and other health-related factors, the odds of experiencing EDS were 5.2 times higher in Internet addicts and 1.9 times higher in possible Internet addicts when compared to non-addicts. This study highlights a strong association between Internet addiction and excessive daytime sleepiness in adolescents. The results suggest that healthcare professionals should consider evaluating Internet addiction as a potential factor in cases of EDS among adolescents (Choi et al., (2009)).

Another study relating IAD and EDS details a field school-based study in Russia. This cross-sectional observational study conducted in three major cities in Central Siberia aimed to investigate the relationship between sleep disturbances, sleep quality, and daytime sleepiness among adolescents with Internet addiction, considering different types of online content consumed. The research involved 4,615 schoolchildren aged 12-18 and employed various scales, including the Chen Internet Addiction Scale, Game Addiction Scale for Adolescents, and Social Media Disorder Scale to identify Internet addiction. The Pittsburgh Sleep Quality Index questionnaire was used to assess nighttime sleep, while the Pediatric Daytime Sleepiness Scale questionnaire evaluated daytime sleepiness. The findings indicated that adolescents with Internet addiction exhibited delayed bedtime and wake-up times, decreased nighttime sleep duration, longer sleep onset latency, frequent nighttime awakenings, and heightened daytime sleepiness. Notably, daytime sleepiness and nighttime awakenings significantly impacted Internet-addicted adolescents, regardless of their media consumption. Consequently, these adolescents require appropriate psychological interventions to address the disturbances in their nighttime sleep quality and excessive daytime sleepiness (Tereshchenko et al., (2021)).

The exploration of IAD and its various aspects, including its relationship with IGD and its connection to EDS, provides a complex picture of modern behavioral challenges. Numerous studies have shed light on the intricate relationship between excessive internet use, IAD, and IGD and their impact on mental health, daily functioning, and sleep patterns.

The research indicates that IAD encompasses a range of addictive behaviors related to various internet activities, including gaming, social media, and online browsing. Differentiating between IAD and IGD is crucial, as both disorders have distinct neurophysiological markers, indicating unique underlying mechanisms. Additionally, studies have highlighted the prevalence of IAD among specific populations, such as medical students and adolescents, emphasizing the need for targeted interventions and preventive strategies integrated into educational curricula.

Furthermore, the studies emphasize the link between IAD and EDS, revealing that excessive internet use, particularly among adolescents, can lead to disrupted sleep patterns and increased daytime sleepiness. These disturbances are significant and impact various aspects of life,

including academic performance and overall well-being. The findings stress the importance of considering internet addiction as a potential factor in cases of EDS among adolescents and the necessity of implementing comprehensive assessments and tailored interventions to address these issues effectively.

Overall, the research underscores the urgent need for continued investigation into IAD and IGD and their implications for mental health and sleep quality. A nuanced understanding of these disorders is essential for developing targeted interventions, public health initiatives, and educational programs to promote healthy internet usage habits and mitigate the adverse effects of excessive internet use on individuals and society. As technology continues to evolve, ongoing research is crucial to adapt prevention and treatment strategies to the changing landscape of internet-related behavioral disorders.

Through in-depth investigations, a robust connection has been established among the underlying structural triggers of IAD, IGD, and EDS. These disorders are not isolated phenomena but are intricately interlinked, forming a complex web of behavioral patterns.

This relationship implies that individuals grappling with IAD often find solace and escape in the immersive world of online gaming or excessive internet use. In turn, these behaviors intensify the manifestations of IAD, pushing affected individuals deeper into the cycle. Simultaneously, the immersive nature of internet gaming and the addictive pull of online activities contribute to disturbed sleep patterns, leading to EDS. The resulting sleep deprivation and daytime sleepiness further fuel the urge to engage in these behaviors, exacerbating the intensity of IAD and IGD.

In essence, IAD, IGD, and EDS are not merely isolated conditions but form a symbiotic network, each condition reinforcing and amplifying the others. This interdependence highlights the need for comprehensive and integrated approaches to addressing these disorders. Simply tackling one aspect of the cycle may not suffice; instead, holistic interventions that consider the intricate connections between these disorders are essential. Recognizing this interplay is pivotal for developing effective prevention strategies, precise diagnostic criteria, and targeted therapeutic interventions. As researchers delve deeper into this intricate relationship, a more profound understanding emerges, enabling the development of tailored solutions to break the cycle and alleviate the impact of these disorders on affected individuals and their overall well-being.
