ODU TIP DERGİSİ/ODU MEDICAL JOURNAL (ODU MED J) December 2025;12(3):170-181

DERLEME / REVIEW DOI: 10.56941/odutip.1834254

Digital Addiction: Epidemiology, Pathophysiology and Management Strategies

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Received: 2 December 2025, Accepted: 31 December 2025, Published online: 31 December 2025

Abstract

Digital addiction is a behavioural addiction that develops as a result of the uncontrolled and excessive use of online platforms such as the internet, smartphones, digital games, and social media. This condition, which is increasingly prevalent among adolescents and young adults, has become a significant public health issue, negatively impacting individual functioning. This review comprehensively examines the epidemiological characteristics, neurobiological foundations, diagnostic criteria, and the relationship between digital addiction and comorbid psychiatric disorders. Neuroimaging studies have revealed structural and functional changes in the frontal lobe, particularly the prefrontal cortex, in individuals with digital addiction. Moreover, dysfunctions in the dopaminergic reward system provide a crucial biological basis for explaining impairments in impulse control and reward expectancy observed in these individuals. Cognitive behavioural therapy (CBT) is central to the treatment process, while exercise-based interventions and novel approaches such as repetitive transcranial magnetic stimulation (rTMS) play a supplementary role. Early intervention programmes, supported by multidisciplinary teams, are of paramount importance in mitigating the individual, familial, and societal burdens associated with digital addiction. One of the most effective strategies for addressing this issue is the early implementation of diagnostic tools alongside cognitive behavioural therapy interventions. It is crucial to raise digital awareness within communities, strengthen educational initiatives aimed at reducing risky usage, and promote healthy digital habits. Mitigating the individual and societal impacts of digital addiction will require a coordinated and holistic approach across health, education, and social policy sectors.

Keywords: Cognitive behavioural therapy, Digital addiction, Internet addiction

Dijital Bağımlılık: Epidemiyoloji, Patofizyoloji ve Yönetim Stratejileri

Özet

Dijital bağımlılık, internet, akıllı telefonlar, dijital oyunlar ve sosyal medya gibi çevrim içi platformların kontrolsüz ve aşırı kullanımına bağlı olarak gelişen bir davranışsal bağımlılık türüdür. Özellikle ergenler ve genç erişkinler arasında giderek artan bir prevalansa sahip olan dijital bağımlılık, bireylerin günlük işlevselliklerini olumsuz yönde etkileyerek önemli bir halk sağlığı sorunu haline gelmiştir. Bu derlemede, dijital bağımlılığın epidemiyolojik özellikleri, nörobiyolojik temelleri, tanı ölçütleri ve eşlik eden psikiyatrik bozukluklarla ilişkisi ele alınmıştır. Nörogörüntüleme çalışmaları, dijital bağımlılığı olan bireylerde özellikle prefrontal korteks olmak üzere frontal lob işlevlerinde yapısal ve işlevsel değişiklikler gözlemlenmiştir. Ayrıca, dopaminerjik ödül sistemindeki disfonksiyon, bu bireylerde dürtü kontrolü ve ödül beklentisi ile ilgili bozulmaları açıklamak adına önemli bir biyolojik dayanak sunmaktadır. Tedavi sürecinde bilişsel davranışçı terapiler (BDT) ön planda yer almakta, ayrıca egzersiz temelli müdahaleler ve tekrarlayan transkraniyal manyetik stimülasyon (rTMS) gibi yenilikçi yöntemler destekleyici rol oynamaktadır. Dijital bağımlılıkla mücadelede erken müdahale programları, multidisipliner ekiplerin iş birliğiyle bireysel, ailesel ve toplumsal düzeydeki olumsuz etkilerin azaltılması açısından kritik bir öneme sahiptir. Sorunun yönetiminde en etkili yaklaşım, erken tanı araçlarının etkin kullanımı ve bilişsel davranışçı terapi temelli müdahalelerin yaygınlaştırılmasıdır. Toplum düzeyinde dijital farkındalığın artırılması, riskli kullanımı azaltmaya yönelik eğitimlerin güçlendirilmesi ve işlevsel kullanım alışkanlıklarının desteklenmesi önemlidir. Dijital bağımlılığın bireysel ve toplumsal etkilerinin azaltılması; sağlık, eğitim ve sosyal politika alanlarının koordineli ve bütüncül bir yaklaşım geliştirmesiyle mümkün olacaktır.

Anahtar kelimeler: Bilişsel davranışçı terapi, Dijital bağımlılık, Internet bağımlılığı

Suggested Citation: Tasdemir Sanci G. Digital Addiction: Epidemiology, Pathophysiology and Management Strategies. ODU Med J, 2025;12(3): 170-181.

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INTRODUCTION

Addiction is a condition characterized by an individual's uncontrollable desire for an object, person, or behaviour, leading them to seek this stimulus beyond their control. It encompasses both physical and psychological dimensions (1,2). Digital addiction is a specific type of behavioural addiction that arises from the excessive, uncontrolled, and repetitive use of digital platforms such as the internet, smartphones, social media, and online games (3). The widespread use of digital technologies in daily life has created diagnostic and therapeutic challenges in healthcare, transforming individual behaviours. In this context, the terms "digital addiction" and "problematic digital media use" have gained prominence in the literature (3).

Digital addiction has diagnostic criteria only for "internet gaming disorder" in the DSM-5, while the World Health Organization (WHO) defines it as "gaming disorder" in its 2019 ICD-11 classification (4). Beyond this, there is no widely accepted diagnostic category for the broader range of digital behaviours, which includes social media, online gambling, smartphones, and streaming services. The integration of technology into daily life has been linked to academic decline, social isolation, sleep disturbances, and psychological issues, particularly among adolescents and young adults (5,6,7).

In the literature, the terms "digital addiction," "problematic digital media use," "internet addiction," and "gaming disorder" are often used interchangeably, despite representing conceptually distinct phenomena. "Problematic digital media use" typically describes maladaptive patterns of digital engagement that may not meet clinical diagnostic thresholds. In contrast, "internet addiction" is a commonly used but non-standardized term that lacks formal diagnostic criteria. "Gaming disorder," on the other hand, is a specific diagnostic entity formally recognized in the DSM-5 (as Internet Gaming Disorder, which requires further study) and in the ICD-11. In this review, the term "digital addiction" is used as an umbrella concept that encompasses various forms of maladaptive digital media use, including excessive internet use, gaming, and social media engagement, while also acknowledging the conceptual and diagnostic distinctions among these terms.

Functional magnetic resonance imaging (fMRI) studies indicate that digital addiction disrupts

dopaminergic circuits that regulate reward sensitivity in the ventral striatum, orbitofrontal cortex, and anterior cingulate gyrus (6). Impairment of the prefrontal cortex heightens impulsivity and the desire for constant pleasure, resulting in greater engagement with digital content (6). Additionally, the interplay between individual factors and environmental context significantly influences the development of digital addiction (7).

Extended screen time increases the risk of sleep disorders, dry eyes, myopia progression, cervical musculoskeletal pain, and metabolic issues associated with a sedentary lifestyle (8,9). On a psychological level, it is linked to social withdrawal, low self-esteem, dissociative tendencies, and increased suicidal thoughts (7,14). Although self-report instruments such as the Young Internet Addiction Test (IAT), Smartphone Addiction Scale Short Form (SAS-SF), and Bergen Social Media Addiction Scale (BSMAS) are used to assess digital addiction, their cross-cultural validity and the absence of common cutoff values limit diagnostic accuracy (10).

Despite the growing body of literature on digital addiction, existing reviews often focus on specific subtypes, such as internet gaming disorder, or examine epidemiological, neurobiological, and therapeutic aspects in isolation. Additionally, the lack of a unified diagnostic framework, combined with the rapid evolution of digital technologies, has led to fragmented evidence regarding the underlying mechanisms, clinical manifestations, and management strategies of digital addiction. As a result, comprehensive and integrative syntheses that connect epidemiology, pathophysiology, diagnostic challenges, and current intervention approaches are limited. This review aims to address this gap by providing a holistic overview of digital addiction, integrating neurobiological mechanisms with clinical features and evidence-based management strategies. This offers a structured framework to guide clinicians and researchers in this evolving field. disciplines.

METHODS

This review was conducted as a narrative, non-systematic review of the literature. Relevant studies were identified through a comprehensive search of electronic databases, including PubMed/MEDLINE, Scopus, and Web of Science. The search covered publications up to February 2025 and utilized combinations of keywords such as “digital addiction”, “internet addiction”, “problematic internet use”, “gaming disorder”, “social media addiction”, “epidemiology”, “neurobiology”, and “treatment”.

Original research articles, systematic reviews, meta-analyses, and authoritative guidelines published in English were considered for inclusion. Studies focusing on the epidemiology, pathophysiology, diagnostic criteria, clinical features, and management strategies of digital addiction were prioritized. Articles were selected based on their relevance, methodological quality, and contribution to the current understanding of digital addiction. Due to the heterogeneity of study designs and outcome measures, a qualitative synthesis approach was adopted instead of a quantitative meta-analysis.

EPIDEMIOLOGY OF DIGITAL ADDICTION

Digital addiction varies by age, gender, and geographic region. Adolescents and young adults, in particular, are at high risk due to their intense and constant exposure to technology (7). Meta-analyses indicate that the prevalence of internet addiction ranges from 1.5-26.7%, with these differences attributed to diagnostic criteria, measurement tools, socio-cultural factors, and sample heterogeneity (11). Geographically, digital addiction rates are higher in Asian countries compared to Western nations; the prevalence of internet and gaming addiction is 10-15% in South Korea, China, and Japan, while it is reported to be 3-8% in Europe and North America (11). These disparities can be explained by cultural norms, access to technology, education, and socioeconomic status (11).

In terms of gender, men are more susceptible to digital game addiction, while women tend to be more susceptible to addictions related to social media and online shopping (7,13). However, the varying theoretical foundations of tools measuring subtypes of digital addiction limit the ability to compare gender differences (12). Social and psychological risk factors particularly depression, anxiety, low self-esteem, social isolation, and impulsivity exhibit a positive correlation with digital addiction (7,13). Additionally, environmental factors and family structure play significant roles in determining the level of risk among adolescents (13).

THE ETIOLOGY AND PATHOPHYSIOLOGY OF DIGITAL ADDICTION

Digital addiction is a multifaceted behavioural addiction shaped by the interplay of psychosocial, neurobiological, and environmental factors. Current theoretical models indicate that individual characteristics, emotional processes, and cognitive control mechanisms play a crucial role in sustaining the addiction cycle (3).

Genetic and Neurobiological Factors

Functional neuroimaging studies indicate that digital addiction is linked to impairments in the regulation of the mesocorticolimbic reward circuit. Deficits in control mechanisms within the prefrontal cortex, orbitofrontal cortex, and anterior cingulate gyrus have been associated with impulsivity, decision-making deficits, and heightened craving responses to online stimuli (6,14).

At the genetic level, polymorphisms in dopamine receptor genes DRD2 and DRD4, the dopamine transporter gene DAT1, and the serotonin transporter gene 5-HTTLPR have been linked to tendencies toward reward addiction and digital addiction (15,16). While these genetic variations may increase the risk by influencing neurotransmission processes, the causal relationship remains uncertain.

Psychosocial Factors

At the psychosocial level, psychiatric characteristics such as impulsivity, anxiety, depression, and attention deficit hyperactivity disorder (ADHD) have been shown to increase the risk of digital addiction. Individuals may use the digital environment as a means of escape and emotion regulation, which provides short-term rewards (7, 17). Additionally, low self-esteem, social isolation, and communication problems within families are significant factors that contribute to the development of addiction.

Among environmental factors, neurodevelopmental vulnerabilities during adolescence, inadequate parental supervision, peer pressure, and unrestricted access to digital technologies at an early age are prominent risk determinants (18).

Pathophysiological Mechanisms

The pathophysiology of digital addiction involves changes in the dopamine-mediated reward cycle, learning processes, and neuroplasticity. As digital stimuli that generate reward expectations are repeatedly encountered, imbalances in dopamine release and dysregulation in prefrontal control networks occur (19). This results in a loss of control over behaviour, increased usage times, and reinforcement of the addiction cycle.

CLINICAL FEATURES AND DIAGNOSIS OF DIGITAL ADDICTION

Digital addiction is characterized by an inability to control usage time, unsuccessful attempts to decrease usage, and withdrawal symptoms such as restlessness and anxiety when access is limited. A significant impairment in social, academic, and occupational functioning due to excessive use is a key feature of this condition (20). Additionally, prolonged digital use has been linked to physical effects, including sleep disorders, eye strain, head and neck pain, and postural problems (21).

Although there is no universal diagnostic system that encompasses all subtypes of digital addiction, Internet Gaming Disorder (IGD) has been defined in the DSM-5 as a condition warranting further investigation. According to the DSM-5, a diagnosis of IGD can be made if at least five of the following nine symptoms have emerged within the past 12 months: excessive preoccupation, withdrawal symptoms, tolerance, unsuccessful attempts to quit, reduced interest in other activities, continued use despite negative consequences, deceptive behaviour regarding use, using gaming to cope with stress, and impaired functioning.

In the ICD-11, Gaming Disorder is characterized by a loss of control over gaming behaviour, prioritization of gaming, and continued use despite negative consequences. This pattern of behaviour must result in significant impairment in personal, family, social, or academic areas and typically lasts for at least 12 months to be considered diagnostically relevant.

Various psychometric tools are employed to assess symptoms of digital addiction. Among the commonly used measurement tools are Young's Internet Addiction Test (IAT), the Bergen Social Media Addiction Scale (BSMAS), and the Smartphone Addiction Scale (SAS) (22). The “Gaming Disorder Scale” is also applicable for evaluating gaming behaviour. These scales measure the individual's frequency of use, emotional responses, and functional impairments through self-reporting.

The clinical interview is essential to the diagnostic process. It is important to examine the individual's digital usage habits, motivations for use, accompanying psychiatric conditions, and the dynamics of their family and social environment in detail. Additionally, identifying which functional areas are impaired by usage enhances the accuracy of the diagnosis (23).

TREATMENT OF DIGITAL ADDICTION

Among the most effective interventions for treating digital addiction are cognitive behavioural therapy (CBT), the development of self-control skills, and motivational interviewing. CBT helps individuals identify problematic usage patterns, modify dysfunctional thought-behaviour cycles, and cultivate healthier coping strategies (24).

Pharmacological treatments have been studied to a limited extent in behavioural addictions, and the evidence base for digital addiction remains limited. Selective serotonin reuptake inhibitors (SSRIs), which target impulsivity and compulsivity, and N-acetylcysteine (NAC), known for its glutamatergic system-modulating properties, have been examined in certain subgroups. While NAC shows promise as a potential adjunctive treatment, the findings are

heterogeneous, and further research is needed. Consequently, pharmacotherapy should be viewed as a complementary option for addressing digital addiction (24).

Psychosocial interventions are a crucial component of treatment, particularly for children and adolescents. Regular exercise programs, family involvement, and parental guidance help restructure usage habits. Preventive strategies include enhancing digital literacy, awareness campaigns focused on risky usage behaviours, and school-based programs (24).

A comprehensive umbrella review published in 2025 revealed that digital addiction is linked to various negative outcomes, including difficulties in emotion regulation, sleep problems, and poor academic performance. However, the quality of evidence in the literature regarding the effectiveness of current treatment approaches is inconsistent, with some methods receiving strong support while data for others are limited or methodologically inadequate. Therefore, there is a need for structured and multi-layered treatment protocols for clinicians (25).

Treatment methods for digital addiction are generally based on a comprehensive framework that includes psychotherapeutic interventions, supportive psychosocial applications, and, in certain cases, pharmacological approaches.

The strongest evidence in this field supports cognitive behavioural therapy (CBT) and mindfulness-based practices. CBT helps reduce the urge to use digital devices and strengthens an individual's self-control by restructuring dysfunctional thought patterns and automatic behaviour cycles associated with problematic digital use. A randomized controlled trial conducted with adolescents in Sweden in 2023 showed that an eight-session relapse prevention-based CBT program reduced Young Internet Addiction Test scores by 35% (25). Mindfulness programs also yield significant benefits, including improved attention focus, reduced impulsivity, and enhanced emotional regulation. A systematic review of 39 studies published in 2024 indicated that mindfulness practices significantly decreased problematic internet use. Similarly, mind–body protocols such as yoga, dance sport, and Tai Chi were found to have positive effects on young adults (26, 27).

It is recommended that treatment not be limited to individual interventions alone but should also encompass the social environment and family dynamics. Group and family-based programs, in particular, activate social support mechanisms by strengthening mutual interaction among adolescents. In addition to multi-component models such as PIPATIC, short-term group CBT programs have been shown to reduce screen time

by approximately 20% (3). These interventions also help individuals restructure their social functioning related to digital behaviours.

Another increasingly important area in the treatment of digital addiction is digital-based interventions. Screen time tracking, usage limitation tools, online psychoeducation modules, and CBT-based e-therapy platforms are practical options that are both accessible and provide users with instant feedback about their behaviour patterns. A comprehensive review published in 2024 reported that such digital interventions reduced weekly screen time by an average of 3.4 hours compared to control conditions (28). These findings indicate that digital technology, while a factor that reinforces addiction, can also serve as a supportive tool for treatment when used correctly.

Evidence in the field of pharmacotherapy is limited, but it may be beneficial, particularly for managing accompanying psychiatric symptoms. SSRIs, bupropion, and methylphenidate have been reported to reduce the severity of Internet Gaming Disorder (IGD) by 15–51%. However, these findings are not widely applicable due to small sample sizes and the predominantly male participants in the studies (29). Among glutamate modulators, N-acetylcysteine (NAC) is noteworthy for its potential to regulate glutamatergic circuits associated with impulsivity and compulsivity. Nonetheless, current data on its effectiveness for digital addiction, as well as for all behavioural addictions, are insufficient, indicating that controlled research is needed (11). Therefore, pharmacotherapy should be considered a complement to psychosocial approaches, which remain the mainstay of treatment.

Another treatment area that has gained attention in recent years is non-invasive brain stimulation techniques. Transcranial direct current stimulation (tDCS) and transcranial magnetic stimulation (TMS), which target the prefrontal cortex, address neurobiological dysfunction related to impulse control and decision-making processes. Research indicates that a 10-session protocol of tDCS applied to the dorsolateral prefrontal cortex can reduce the urge to gamble by approximately 25%. However, due to the limited number of studies and methodological differences, standardized treatment protocols have not yet been established. TMS studies are still in their early stages, and the results remain inconsistent. Therefore, brain stimulation methods are currently in the research phase, and their application in clinical practice should be approached with caution.

The treatment of digital addiction is too multidimensional to be explained by a single method. The most effective approach combines

psychotherapeutic interventions with family or group support, and, when necessary, reinforces these with digital behaviour modification tools. Pharmacotherapy and brain stimulation techniques play a supportive role only in select cases and with limited evidence. Therefore, the treatment plan should be structured holistically, considering the individual's psychosocial context, accompanying mental symptoms, and the characteristics of their digital usage patterns.

INTERVENTION AND APPLICATION RECOMMENDATIONS

The first step in managing digital addiction is identifying at-risk individuals through brief screening scales. Cognitive behavioural therapy-based interventions have proven effective for those identified as at risk (30). This approach focuses on recognizing problematic usage, enhancing self-control, and fostering a healthier relationship with the digital environment.

In resistant cases, pharmacotherapy or neuromodulation techniques may be considered as adjunctive options; however, the evidence supporting these methods is limited. Given the heterogeneous nature of digital addiction, it is essential to tailor interventions based on age, gender, psychosocial characteristics, and coexisting mental health symptoms. Long-term, multicenter randomized controlled trials are necessary to more clearly determine the effectiveness of these intervention models (30).

CONCLUSION

Digital addiction has emerged as a significant public health issue, particularly among young people, due to its increasing prevalence and negative effects on psychosocial functioning. Excessive digital use is linked to decreased academic performance, social isolation, and mental health problems. This situation diminishes individual quality of life and increases demand for healthcare services, adding strain at the system level.

One of the most effective strategies for addressing this issue is the early implementation of diagnostic tools alongside cognitive behavioural therapy interventions. It is crucial to raise digital awareness within communities, strengthen educational initiatives aimed at reducing risky usage, and promote healthy digital habits. Mitigating the individual and societal impacts of digital addiction will require a coordinated and holistic approach across health, education, and social policy sectors.

Ethics Committee Approval: This article is a review of previously published literature. Since it does not involve any studies with human participants or animals conducted by the authors, ethical approval was not required.

Author Contributions: Conception – Gulsen Tasdemir Sanci; Design - Gulsen Tasdemir Sanci; Supervision - Gulsen Tasdemir Sanci; Data Collection and/or Processing - Gulsen Tasdemir Sanci Literature Search - Gulsen Tasdemir Sanci; Writing - Gulsen Tasdemir Sanci; Critical Review - Gulsen Tasdemir Sanci

Conflict of Interest: The authors declare that they have no conflict of interest in this study.

Financial Disclosure: The authors declared that this study has not received no financial support.

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