Narrative review articles

# Use and abuse of mobile devices and their role in the development of sleep disorders in adolescents

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**Uso y abuso de dispositivos móviles y su rol en el desarrollo de trastornos del sueño en adolescentes**

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JACI [1]: introduction, sleep disorders and conclusions. MABR[2]: summary, introduction, association between the use of ICT and sleep disorders and conclusions. PMDCA[3]: summary, introduction, pandemic and conclusions. DCIL[4]: introduction, sleep profiles and conclusions. HEMS[5]: introduction, insomnia, sleep disorders and conclusions.

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The authors declare there is no conflict of interest.

**Abstract**
Information and communication technologies represent an advance for society. Nowadays, mobile devices provide convenient services for everyday life, facilitating communication triggers, leisure and interpersonal relationships, however, it is described that their excessive use influences the appearance of symptoms such as anxiety, addictive behaviors and sleep disturbances. Adolescents are a particularly affected group, with easy access to this technology from an early age and its consequent integration into their daily life. Therefore, it is intended to determine the role played by the use and abuse of mobile devices in the development of sleep disorders in adolescents. Despite their deleterious effects, it has been observed that the use of these technologies can cause a feeling of well-being and social support in some users, particularly when it promotes interaction with their peers. The excessive use of these technologies, especially hours before sleeping, is related to an abnormal sleep patterns, it has been identified that the most prevalent sleep disorders in users are insomnia and excessive daytime sleepiness.

**Keywords**
Teenagers, dyssomnias, information technology, sleep, internet.

**Resumen**
Las tecnologías de información y comunicación suponen un avance para la sociedad. Hoy en día, los dispositivos móviles proveen servicios convenientes para la cotidianidad, facilitando la comunicación, el ocio y las relaciones interpersonales, sin embargo, se describe que su uso excesivo influye en la aparición de síntomas como ansiedad, comportamientos adictivos y alteraciones del sueño. De todos los usuarios de estas tecnologías, los adolescentes son un grupo especialmente afectado, debido al fácil acceso a estas desde edades muy tempranas y la consecuente integración a su vida diaria. Por lo que se pretende determinar el papel del uso de dispositivos móviles en el desarrollo de trastornos del sueño en adolescentes. Pese a sus efectos deletéreos, se ha observado que el uso de estas tecnologías puede ocasionar sensación de bienestar y apoyo social en algunos usuarios, particularmente cuando promueve la interacción con sus pares. El uso excesivo de las tecnologías, en especial horas antes de dormir, se relaciona con un patrón de sueño anómalo, se ha identificado que los trastornos del sueño más prevalentes en los usuarios son el insomnio y la somnolencia diurna excesiva.

**Palabras clave**
Adolescentes, disomnias, tecnologías de la información, sueño, internet.

## Introduction

Nowadays, mobile devices provide convenient services for everyday life, facilitating communication and interpersonal relationships for approximately 2,87 billion users in 2020[1]. The adolescent population has as a habit the use of information and communication technologies (ICT) from an early age, which allows them to develop friendships and find a space independent of parents, but their excessive use is associated with the appearance of addictive behaviors in users, according to the results of Cha *et al*.[2].

The current context of confinement gives ICTs an important role in socialization,

increasing their use. The online study also increases the time of exposure to the devices, affecting sleep quality[3,4]. The problematic use of ICTs in adolescents manifests itself with symptoms of dependence and withdrawal, also causing school absenteeism, aggressiveness, anxiety, sleep disturbances or poor academic performance[5].

In the United States of America, Hale L, *et al.* reported 51 % of people with significant impacts on mood, daily functioning and interpersonal relationships in 2018[6]. Besides, the use of internet as entertainment promotes a shorter sleep pattern and decreases its quality[7].

During adolescence, changes occur that require good sleep habits, so it takes between 8 and 10 hours for adequating psychophysiological development[8]. According to the American Psychiatry Association (APA), sleep disorders are characterized by problems in the quality and quantity of sleep[9].

The use of social networks is related to negative effects on sleep, interpersonal relationships and work and school performance[10]. ICTs are considered to displace or interrupt sleep time, provide stimulating content and alter the circadian cycle[11]. Also, alterations in adolescent sleep patterns are related to an increase in mood disorders, anxiety, substance abuse, behavioral problems and suicidal ideations[12]. Therefore, it is intended to determine the role played by the use and abuse of mobile devices in the development of sleep disorders in adolescents.

## Developments

### Sleeping profile and sleeping disorders in adolescents

Sleeping is a physiological process and a biological need of human beings that allows them to achieve an adequate state of health. It consists of a relative stage of physical inactivity in which psychological, neuroendocrine, gastric and intestinal functions are restored, which are vital for full performance and the person is in a state of rest and recovery[13].

The quality of sleep depends on several factors related to the people, the stages of their sleep cycle, the consumption of medications, stimulants such as caffeine and theine, exercises, work environment or some diseases, and other environmental aspects, such as the use of technological devices. The Pittsburgh Sleep Quality Index (SCI) is a standard instrument for measuring sleep by which its different determinants are analyzed. These are grouped into seven components: quality, latency, duration, efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. It has a score from 0 to 21, where the higher the score the worse the quality of sleep[14].

According to a study conducted by the University of Granada, Spain in 2002, in which the amount of sleep was measured in hours, it was considered that if you sleep 5,5 hours or less a day, it is a short sleep pattern; 9 hours or more is a long sleep pattern and between 7 and 8 hours is an intermediate sleep pattern[15].

As for sleep disorders, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), insomnia is defined as a predominant dissatisfaction with the quantity or quality of sleep, which can be presented as difficulty falling asleep, maintaining it or waking up early in the morning and being unable to go back to sleep; this symptomatology occurs at least three days a week for a period of time equal to or greater than three months[16].

Now, the prevalence of insomnia in adolescents aged 16–18 years corresponds to 18,5 % with a predominance of the female sex (23,8 %)[17]. The exact cause of why women have a higher percentage is unknown, but it is believed that the onset of menstruation is an event that increases the risk of developing this pathology[18].

The impact of insomnia on the normal life of the adolescent occurs in different ways, such as daytime sleepiness, alterations in daytime care and decreased health-related quality of life index (HRQOL)[19]. Apart from the consequences described before, there is evidence that insomnia also serves as a risk factor for suicide. Nowadays, the U.S. Institutes of Medicine estimate that for every death by suicide among adolescents, there are other 100 adolescents with suicide attempts[20].

In addition to insomnia, excessive daytime sleepiness (EDS) is a common problem that affects the adolescent population. In 2019 Liu *et al.* observed that SDE affects approximately 29 % of adolescents and increases as they go through puberty: an increase in prevalence of 19,8 % is observed in the Tanner 1 stage (pre-puberty) and 47,2 % in the Tanner 5 stage (post puberty). Also, the female gender has a higher prevalence since the Tanner 3 stage (half puberty)[21].

In 2016, Vilela *et al*. noted that among the factors that can increase the risk of excessive daytime sleepiness is reported sleep

deprivation, which has a prevalence of 39 % in this age group and increases with age. Besides, it has been observed association with sleep hyperhidrosis and an evening chronotype; Symptoms of insomnia and use of electronic devices for more than an hour a day are associated with the presence of SDE[22]. One of the factors most related to SDE is the subjective need reported by adolescents for longer hours of sleep, as observed by Ferrari *et al.*[23].

Besides, mental illness and high academic stress are risk factors for developing SDE. In 2018, Luo *et al.* observed within a rural population of adolescents in China a two-way association between SDE and symptoms of depression and anxiety, which may indicate that there is a complex relationship between mental illness and sleep disturbances in adolescents[24].

This can cause in the lives of adolescents a lower academic performance, lack of development of cognitive function, use of substances and alterations in mood, also being associated with serious problems such as the increase in car crashes, which can lead to death[25].

## Influence of mobile device use on sleep disorders

ICTs have gained popularity among the young population, especially with the development of social networks, mobile devices and video games[26]. However, its excessive use has repercussions both physically and psychologically, becoming associated with the consumption of drugs such as alcohol, tobacco or cannabis, poor academic performance and conflicting family relationships[5]. The relationship between problematic cell phone use and video games with avoiding negative feelings has been demonstrated[27].

Scales have been developed to classify the use of ICTs, among which are the MULTICAGE-ICT scale, created from the MULTICAGE-CAD scale for addictive and compulsive behaviors and the CAGE questionnaire for alcoholism in order to adapt to modern behavioral addictions[2].

MULTICAGE-ICT is composed of twenty dichotomous questions divided into five scales, and evaluates problems related to the use of mobiles, internet, instant messaging, video games and social networks, allowing to identify those users with problematic use of ICT. This questionnaire has demonstrated predictive value for items about attention problems, emotional instability, emotional problems and inhibitory problems in social behavior. Therefore, it is considered a useful tool to identify those users with problematic behaviors due to the excessive use of mobile devices or other technologies[28,29].

In 2016, Kuss *et al.* define the term "problematic use of the internet" (UPI) as one that interferes with the user's daily activities[30], with sleep disturbance being one of the most frequent comorbid conditions. It is suggested that the nocturnal use of ICTs directly interferes with the circadian cycle and causes irregular sleep patterns, with insomnia being one of the main consequences[31].

According to Dube *et al.*, in 2017, the presence of entertainment and communication technologies and their use in the hour before bedtime, is negatively associated with the duration, quality and efficiency of sleep, causing the loss of 10,8 minutes of sleep for children who use cell phones one hour before bedtime, 10,2 minutes for children who use computers and 7,8 minutes for those who use television one hour before bedtime. A deficiency of 15 minutes of sleep duration is enough to produce clinical effects and this limit decreases when more than one device is used. The greatest impact is produced by the use of cell phones one hour before sleep, decreasing the quality of sleep by 36 %[32].

In 2016, Johansson *et al.* observed in a population of 259 adolescents between 13 and 21 years old, that 97 % make use of some technology one hour before bedtime, 47 % use three or four devices before sleeping and 10 % use six or more, and that the use of multiple devices is significantly associated with a shorter duration of sleep, lighter sleep and waking up early, in a population of 259 adolescents between 13 and 21 years old. They determined using the Epworth sleepiness scale that internet use before sleep is significantly associated with excessive daytime sleepiness and absence of restful sleep (Rho =0,15 to 0,31, p <0,05)[33].

In 2015, according to Hysing *et al.*, the use of ICT can alter sleep by consuming the time that would normally be dedicated to it, causing physiological alertness through stimulating content or altering the circadian cycle through exposure to bright light[34].

Also, the use of ICT during the night has been associated with later sleep hours, nightmares, sleepwalking and decreased sleep regeneration capacity[35]. Similarly, Scott *et al.*, in 2019, in a cohort of 11,87[2] adolescents between 13–15 years, determined that 13,9 % use ICT between 3–5 hours a day and 20,8%, more than 5 hours. This overuse was associated with late sleep onset with Odds Ratio (OR) of 2,14, wakefulness on

school days, and trouble falling back asleep after waking up at night (OR 1,36)[36].

In 2017, Li *et al*. looked for the association between internet addiction, social media addiction and the presence of insomnia in a sample of 1015 high school students. The prevalence of insomnia for the general population was 37,2 %; however, it was 65,9 % for subjects with internet addiction and 54,1 % with social media addiction obtaining OR of 2,87 and 2,19, respectively. The authors conclude that there is a significant association between prolonged internet use and the presence of insomnia in adolescents[37].

### Influence of COVID-19 lockdown on ICT use and sleep pattern

COVID-19 and its rapid spread caused the World Health Organization (WHO) to declare an international public health emergency on January 2020 and global rigid quarantines to be established in March. The closure of schools, coupled with economic insecurity, social distancing, decreased mobility and concern about the pandemic, has altered the routines of children and adolescents, generating fear, anxiety, aggressive behaviors or disobedience, also increasing the risk of suicidal tendencies[38].

Although the excessive use of ICTs is associated with various negative effects, the pandemic has made them indispensable and even beneficial, as schools have adapted themselves to online platforms and adolescents can interact with their peers through social networks, video games or other interactive activities. In 2021, According to Nagata *et al.*, the use of ICTs could represent an advantage in dealing with social distancing in those children and adolescents familiar with these[39].

In 2020, Ying *et al.* observed that in children aged 5 to 14 years who receive online classes, 68,8 % of parents reported 3 hours or more of ICTs use, exceeding the recommended maximum of 2 hours. 84,4 % reported less than 2 hours of outdoor time[40]. In 2020 Drouin *et al.* found that children with high levels of anxiety more frequently turn to ICT and social networks to interact with others or to inform themselves, while children with better socioeconomic abilities and with low anxiety symptoms resorted less to these[41].

During the first month of confinement in 20202, Cellini *et al.* reported an increase in activities involving the use of ICT in the 2 hours prior to sleep, which was associated with increased sleep latency and a delay in bedtime. Besides, people with symptoms of depression, anxiety and stress, particularly students and employees, demonstrated reduced sleep quality and temporary disorientation[42].

Romero-Blanco *et al.* compared the quantity and quality of sleep in nursing students before and after quarantine, finding an increase in time spent in bed and sleep latency, the latter related to the inappropriate use of TIC3 in 2020. According to Leone *et al.*, the effects of quarantine on sleep and the circadian cycle were greater as the age of the subjects decreased in 2020[43].

According to Orben *et al.*, isolation alters neural patterns in the nigra substance, causing feelings of loneliness and decreased happiness in 2020. In adolescents, the active use of social networks, with direct interaction with other people, can alleviate the feelings associated with isolation, provoke feelings of well-being and give access to social support. Therefore, the effect of the use of ICT on adolescents in confinement will be beneficial if it promotes interaction and direct connection with their peers, while passive activities such as watching photos or videos offer no benefit[44].

## Conclusions

Excessive use of information and communication technologies in the adolescent population, especially hours before sleep, is related to an abnormal sleep pattern, which is identified in a decrease in its quality and quantity. It has been found in literature related to this matter that the most prevalent sleep disorders in ICT users are insomnia and excessive daytime sleepiness.

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