

# Sleep and Media Screens in Pediatric Ages

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## ABSTRACT

**Introduction:** Sleep plays an essential role in children's physical, emotional and behavioral health. Understanding the sleep architecture, sleep duration requirements as well as the interference of media screens activity with sleep across pediatric ages is essential in order to provide an adequate anticipatory guidance for the children's parents.

**Objectives:** To review current knowledge on sleep physiology with a particular focus in sleep duration requirements across pediatric ages and on the influence of media screen activity on children and adolescent sleep.

**Methods:** Revision of meta-analysis research studies, systematic reviews, standards of clinical orientation and original research published in Portuguese or English between 01/2000 and 08/2017 on Pubmed / Medline using the following MeSH terms: sleep; sleep requirements; sleep physiology; media screen; child and neurodevelopment.

**Development:** Sleep architecture and sleep duration requirements undergo constant change with age. Despite interindividual differences, optimal sleep duration intervals as well as nap times, which constitute an essential component of children's sleep, should be followed. Along children's age progression, other parameters need to be considered in order to maintain optimal sleep quality. The restriction of media screen use at bedtime assumes special relevance, as there is growing evidence pointing towards an association between shortened sleep time and the misuse of screen devices. Adolescents represent a particularly vulnerable population to media screens effects. Importantly, screen overuse and media content may be responsible for higher propensity for obesity, risky behavior, depression, impaired academic performance, decreased social skills and attention difficulties.

**Conclusion:** Anticipatory guidance for parents addressing sleep optimization and media exposure should be routinely

provided as a part of health follow-up. Physicians should be capacitated to recognize symptoms or behaviors that may lead to the suspicion of screen misusing as well as to recognize children with high risk of media screen overuse.

**Keywords:** Anticipatory guidance; media screens; sleep physiology; sleep requirements; sleep

## SONO E TEMPO DE ECRÃ EM IDADE PEDIÁTRICA

## RESUMO

**Introdução:** O sono desempenha um papel essencial no bem-estar físico, emocional e comportamental das crianças. A compreensão das particularidades fisiológicas do sono das crianças e das suas necessidades no que diz respeito à duração do sono são essenciais para a adequada transmissão dos cuidados antecipatórios aos pais.

**Objetivos:** Revisão da literatura científica relativa à fisiologia do sono dando particular destaque à duração ótima de sono nas diferentes idades pediátricas e à potencial influência da utilização de ecrãs multimédia na qualidade do sono.

**Métodos:** Revisão de estudos de metanálises, revisões sistemáticas, normas de orientação clínica e estudos originais publicados em português ou inglês entre 01/2000 e 08/2017 na base de dados Pubmed / Medline usando os seguintes termos MeSH: sono; duração de sono; fisiologia do sono; ecrã multimédia; criança e neurodesenvolvimento.

**Desenvolvimento:** Tanto a arquitetura do sono como a sua duração variam com a idade. Embora existam diferenças entre indivíduos, há intervalos de referência para a duração de sono noturno e de sestas que devem ser cumpridos. Com a progressão da idade, devem ser ainda equacionadas outras variáveis no sentido de optimizar a qualidade do sono. A restrição do uso de ecrãs multimédia, especialmente no período noturno, é essencial, dada a crescente evidência de associação entre o uso excessivo destes dispositivos e uma má qualidade de sono. Os adolescentes são o estrato etário mais vulnerável aos ecrãs multimédia. O uso excessivo destes dispositivos, bem como o próprio conteúdo acedido, podem ser responsáveis por uma maior propensão para obesidade, comportamentos de risco, depressão, desempenho escolar medíocre, diminuição das competências sociais e dificuldades de atenção.

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**Conclusão:** Os cuidados antecipatórios relacionados com a otimização do sono das crianças e com a utilização adequada de ecrãs multimédia devem ser rotineiramente abordados como parte integrante de uma consulta de promoção de saúde infantil e juvenil. O médico deverá ser capaz de reconhecer sintomas ou comportamentos sugestivos de um uso inadequado dos ecrãs multimédia, bem como identificar crianças com risco acrescido de uso excessivo destes dispositivos.

**Palavras-chave:** Cuidados antecipatórios; ecrãs multimédia; fisiologia do sono; duração do sono; sono

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## INTRODUCTION

Human neurodevelopment, especially in the first years of life, occurs at a rapid pace, remaining a challenge for health professionals to screen normal development milestones, in physical, motor, cognitive, linguistic and social-emotional domains, within the expected timeframe. In addition to the early identification of potential neurodevelopmental disorders, which allows a more effective intervention in optimizing the child's abilities, the importance of anticipatory guidance for parents in promoting optimal neurodevelopmental outcomes should also be highlighted. Primary care physicians play an essential role in providing this guidance, as they constitute the most frequent professionals sought out by parents for child-rearing advice. Among the various topics that should comprise parent's anticipatory guidance, sleep quality and its duration as well as optimization of media screen activity are, definitely, essential themes. Their relevance is given not only by its association with different child and adolescent health domains but also due to being a frequently point raised by parents during health maintenance visits.

## OBJECTIVES

This article aims to review the scientific knowledge on sleep physiology with a particular focus on sleep duration requirements across pediatric ages and the influence of media screen activity and content on children and adolescent sleep quality.

## METHODS

Revision of meta-analysis research studies, systematic reviews, standards of clinical orientation and original research published in Portuguese or English between 01/2000 and 08/2017 on Pubmed / Medline using the following MeSH terms: sleep; sleep requirements; sleep physiology; media screen; child; neurodevelopment.

## DEVELOPMENT

### Sleep disorders

#### *Prevalence of sleep disorders*

Overall prevalence of sleep disorders in childhood remains difficult to estimate. While some reports present as few as 3.7% of youths (age 0 to 18-years-old) with formal sleep disorder diagnosed in Primary Care networks, other authors have reported that up to 50% of all children experience sleep problems.<sup>1,2</sup> In Portugal, recent studies assessing the prevalence of sleep disorders in childhood had also shown highly variable results with prevalence ranging from 10 to 75%.<sup>3-5</sup>

#### *Sleep disorders' impact on health*

There is cumulative evidence that inadequate sleep in childhood is associated with reduced neurobehavioral functioning leading to attention disturbs, poor decision-making and decreased memory, which may contribute to a poorer academic success.<sup>6,7</sup> In agreement, a similar association was reported in a Portuguese study evaluating a pediatric population (ages two to ten-years-old) in which a higher academic success was related to an overall lower sleep disturbance index.<sup>8</sup> Other reports have also found associations between short or inadequate sleep duration and obesity, insulin resistance and hypertension.<sup>9-11</sup> It is also important to highlight that sleep deprivation in adolescents may confer increased risk of depression and suicidal ideation, as well as misbehavior, as a consequence of impaired emotional regulation.<sup>12-14</sup> Furthermore, children's sleep disorders and frequent night awakenings have also been associated with an higher risk of maternal depression which, in turn, may increase inter-partner and parent-child conflicts, further contributing to sleep disturbs.<sup>15,16</sup>

### Sleep architecture and sleep duration requirements

Sleep architecture changes continuously and considerably with age progression. The most prominent differences in children's sleep architecture when compared with adults are the following:

1. an increased duration of Rapid Eye Movement (REM) sleep - in the earlier months of life infants spend around 50% of their sleep time in REM sleep, by the first year the proportion of REM sleep lowers to 30% and, in adulthood, it decreases to 20%;<sup>17</sup>
2. sleep entrance through active REM sleep - a process that gradually changes over the first year of life;<sup>17</sup>
3. a shorter REM/non-REM cycle duration - in the earlier months of life each cycle lasts 40-60 minutes and progressively increases until it reaches the 90-100 minute of the adult-cycle in adolescence.<sup>18</sup>

This particular sleep architecture accounts to the distinct pattern of sleep and wakefulness within the first months of life. Around the age of three months, circadian rhythms begin to establish, leading to sleep consolidation, which results in a greater duration of wakefulness during the day and longer

periods of night sleep.<sup>19</sup> Therefore, anticipatory guidance for parents is essential, in order optimize children sleep during the first months of life and to promote healthy sleep routines.<sup>20</sup>

In addition, sleep requirements also change across different ages. Although significant interindividual differences exist, optimal sleep duration intervals have been proposed for pediatric ages. The newest recommendations of the American Academy of Sleep Medicine state that:<sup>21</sup>

- Children age 4- to 12-months-old should sleep 12 to 16 hours per day (including naps);
- Children age 1- to 2-years-old should sleep 11 to 14 hours per day (including naps);
- Children age 3- to 5-years-old should sleep 10 to 13 hours per day (including naps);
- Schoolers age 6- to 12-years-old should sleep 9 to 12 hours per day;
- Teenagers age 13- to 18-years-old should sleep 8 to 10 hours per day.

An aspect that should be highlighted is the nap time in newborns, toddlers, infants and preschoolers. Children up to the age of two years-old should fulfill part of their sleep needs by taking one or two daytime naps. Napping progressively declines, so that at five years of age the majority of children sleep only at night, although some still need a daytime nap. A growing body of evidence points towards the importance of napping in children neurodevelopment, namely in learning skills and memory consolidation.<sup>22</sup> It has been recently suggested that following a missed nap, toddlers experience a physiologically significant homeostatic challenge in the subsequent night, resulting in a shorter sleep latency, longer sleep duration and increased slow wave activity.<sup>23</sup> Sleep-related anticipatory guidance for parents should therefore highlight napping as an essential component of children's sleep.

### The influence of media screens activity on sleep

#### *Birth to 5-years old*

The use of media screens, either television, computer screens, tablets, videogames or smartphones, is widely generalized in the pediatric population from a very early age and it is becoming common to find these devices in children's bedroom.<sup>24</sup> An increasing number of epidemiological studies suggest that screen-based activities in the bedroom are the main environmental source accounting for delayed bedtime or shortened total sleep time.<sup>25</sup> In agreement, a recent study on a Portuguese pediatric population (ages two to ten-year-old) has shown that watching television or playing videogames before falling asleep were related to an increased sleep disturbance index.<sup>8</sup> The association between screen activity and insufficient or low quality sleep may be explained by different mechanisms. In addition to the fact that the time spent in front of screens determines less time available to sleep, other factors, rather than time consumption, are also involved in sleep disturbances. There is evidence that devices with light-emitting diode (LED) screens (e.g. tablets), which are known to emit short-wavelength-enriched light (blue light), reduce the release of the sleep-promoting hormone melatonin, therefore

attenuating the circadian drive for sleep and contributing to sustained attention and alertness.<sup>26</sup> It has also been shown that exposure to blue light close to bedtime delays sleep onset, as it interferes with sleep architecture by increasing the slow-wave latency or reducing REM sleep.<sup>27</sup> Taking into consideration the exponential use of newer digital technologies by infants and young children on a daily basis and its potential role on their well-being and neurodevelopment, the American Academy of Pediatrics has recently released a policy statement addressing guidance for parents in managing their young children's media use. Major recommendations, that go beyond the influence of screens on children's sleep, are summarized in Table 1.<sup>28</sup>

#### *Adolescence*

Adolescents are a particular population regarding the use of media screens, as these devices have progressively become an integral part of their daily lives and frequently skip parental control. Moreover, with the increasing technology portability, these devices have commonly moved into bedrooms, accounting for a prevalence of almost 100% regarding the use media screens near bedtime in US adolescents.<sup>24</sup> Similar to the stated above for the birth to five years-old age strata, there is accumulating evidence of a negative association between media screen technology use and sleep in adolescents. This association was recently shown both in a large population-based study with near 10.000 adolescents and in a meta-analysis that evaluated the effect of media devices on sleep outcomes in around 125.000 children aged from 6 to 19 years-old.<sup>29,30</sup> Regarding media use, it was further reported that in a pool of 727 Portuguese adolescents (mean age of 13 years-old) internet dependence was associated with self-perceived sleep problems, initial and middle insomnia and excessive daytime sleepiness.<sup>31</sup> It is also important to highlight that different media screen may have different outcomes in adolescent sleep. Whereas conventional electronic devices such as televisions, gaming consoles and computers are known to negatively impact sleep, newer portable media devices, including smartphones and tablets, can have an even greater impact due to their real-time interaction and therefore continuous stimulation of children.<sup>25</sup> Bedtime text messaging assumes a particular relevance regarding the latter.<sup>32,33</sup>

Different sleep outcomes have been measured and positively related to bedtime media screen use by adolescents, such as inadequate sleep quantity, poor sleep quality, excessive daytime sleepiness or sleep onset latency.<sup>29,30</sup> Other reports have focused on the consequences of media screen use in sleep time and adolescent lifestyle changes. It has been showed that night-time use of media screens is associated with shortened sleep duration and overweight and obesity.<sup>34</sup> In addition, it was reported that higher periods of screen time are associated with more sleep disturbances which, consequently, are linked to higher levels of youth behavioral and health problems.<sup>35</sup> Similarly, a study that evaluated a pool of near 3500 Portuguese students (mean age of 14.9 years-old) found that risk behaviors, including alcohol and drug consumption, hetero-aggressive and sexual behaviors, are significantly more prevalent in sleep deprived adolescents.<sup>36</sup> In

**Table 1** – Advice for parents regarding the use of media screen in pediatric ages. Adapted from (28).

Age	Advice
< 18 months	<ul style="list-style-type: none"> <li>- Avoid digital media use in children younger than 18 to 24 months (except video-chatting when needed).</li> </ul>
18 – 24 months	<ul style="list-style-type: none"> <li>- When introducing digital media, parents should co-play or co-view media together with their children to improve hands-on exploration, social interaction and learning from digital media content (parents should teach the media content after watching it with children).</li> <li>- There is no need to introduce technology early; interfaces are intuitive so that children will learn quickly once they start using them at home or in school.</li> </ul>
2 – 5 years old	<ul style="list-style-type: none"> <li>- Limit screen use to 1 hour per day of selected programming. Parents should explain media content and help children apply what they have learned to their surroundings.</li> <li>- Avoid screen activity 1 hour before bedtime and maintain the bedroom a screen free zone (even emitted light from devices charging may still affect the quality of the children's sleep).</li> <li>- Keep mealtimes a screen free zone (watching television during meals is associated with weight gain in children, as well as it discourages interaction with the family).</li> <li>- Avoid using media as the main strategy to calm children (this may contribute to impair development of children's own emotion regulation).</li> </ul>
> 5 years old	<ul style="list-style-type: none"> <li>- Limit screen activity when doing homework, at school or while in the car.</li> <li>- Balance online versus off-line time (while moderate use of media or digital devices brings educational benefits, face-to-face time with family, friends or teachers has an even more important role in promoting children's learning and healthy development).</li> <li>- Educate on being a good digital citizen including not being rude or bullying anyone online and respecting the privacy of others.</li> <li>- Educate on digital safety rules including not sending personal information online, not sharing private photos online and not establishing friendship with someone without a parent's permission.</li> </ul>

addition to obesity and risk behaviors, the use of media screen and sleep deprivation in adolescents have also been associated with a higher risk of depression, impaired academic performance, decreased social skills and attention difficulties.<sup>37-40</sup>

Besides to the media screen usage time, is it also of critical relevance the media screen content. On one hand, media screens can be a useful source of health information and education since, due to the anonymity of the internet, adolescents may feel more comfortable in searching online for sensitive health topics such as sexually transmitted diseases, depression, pregnancy or birth control. Also, social networks can serve as a tool to strengthen existing friendships and to establish new ones.<sup>41</sup> On the other hand, media screen content can have a relevant negative impact on sleep and on modelling adolescent behavior. It is known that the stimulating content of media may result in heightened alertness, physiological arousal and difficulty in falling asleep, as it has also been established that exposure to media violence, either in television or videogames, or to media sexual content, associates with increased real-life aggressive behavior and early sexual debut with increased risky sexual behaviors, respectively.<sup>42-44</sup>

#### CONCLUDING REMARKS

Sleep plays an essential role in physical, emotional and behavior health of children and adolescents. Understanding sleep architecture and sleep duration requirements across

pediatric ages remains essential to provide adequate anticipatory guidance for parents. Parents should be made aware that despite individual differences, optimal sleep duration intervals should be followed, as well as nap times - an essential component of children sleep. With children's age progression, other issues should also be considered in order to maintain optimal sleep quality. Taking into account the growing body of evidence supporting an association between shortened total sleep time and the use of bedtime media screens, parents should regulate screen use, as well as maintain bedrooms a screen free zone. This goal can be more difficult to achieve with adolescents, since mobile screen devices have progressively become an integral part of their life and a main component of their social interactions. Moreover, parents should be informed of the potential harms of excessive media screens use, which include greater propensity for obesity, risky behaviors, depression, impaired academic performance, decreased social skills and attention problems. Physicians, in addition to routinely provide anticipatory guidance addressing media exposure as a part of the health maintenance visit, should also be able to recognize symptoms and behaviors evoking screen misusing.

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