Electronic Media Use and Sleep in Children and Adolescents: A Systematic Review

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Abstract

Background In recent years, there has been an increasing interest in whether the use of electronic media affects children and young adolescents' sleep. We performed a systematic review of the association between electronic media use and sleep outcomes among 0-15-year-olds.

Methods Searches were carried out in four databases (CINAHL, Web of Science, EMBASE, and Medline). Additional studies were identified by hand-searching reference lists of retrieved systematic reviews and meta-analyses. Inclusion criteria were age range from 0 to 15.9 years, in English, and intervention studies, cohort studies, and cross-sectional studies from western countries. Qualitative studies were excluded due to a low number of identified studies. Exclusion criteria were study populations with psychiatric diagnoses, obesity, or any sleep disorder.

Results The search identified 10,719 unique studies, of which 108 fulfilled the inclusion and exclusion criteria and were assessed for methodological quality. In total, 49 studies were included in the review. The study designs were randomized controlled trials (n=3), quasi-experimental studies (n=two), prospective cohort studies (n=15), and cross-sectional studies (n=29). Evidence for an association between electronic media use and sleep duration was identified; particularly excessive electronic media use and bedtime use. The evidence was stronger for 6-15-years-olds than 0-5-year-olds. The relationship between electronic media use and other sleep outcomes was more inconclusive.

Conclusions Overall, electronic media use was generally associated with shorter sleep duration in children and adolescents aged 0-15. Studies with stronger research design and of higher quality are needed to draw solid conclusions about electronic media's impact on sleep outcomes and gain better understands of the mechanisms behind the associations. Public awareness and interventions could be promoted about the potential negative impact on children's sleep duration of electronic media devices that are used excessively and close to bedtime.

Background

Sleep has a major impact on the health and well-being of children and adolescents. Sleep is vital for development and learning ability, and insufficient sleep over an extended period can have long-term physical and psychological health implications [1]. Physiological changes that emerge in childhood and youth may impact negatively on sleep, but poor sleep is arguably also related to, or compounded by, external factors such as the increasing use of electronic media [1-3]. The use of electronic media has changed the way we communicate and interact with one another in everyday life [4]. Studies demonstrate that most children, even as young as four months of age, have experience with using electronic media devices, although electronic media consumption is largest among older teenagers [5].

Technology is continuously evolving, and the way electronic media devices are used in everyday life is changeable and constantly negotiated in the public and private spheres. Although previous systematic

reviews and meta-analyses have established a correlation between media use and sleep [6-8], it is crucial that research continuously addresses the processes of technology and media use and its implication on children and adolescents' sleep patterns. Therefore, reviews that include the newest types of electronic media devices and technological trends are needed. Moreover, previous reviews on this subject focus mainly on an older paediatric target group, and there is limited knowledge about the evidence of electronic media devices and the impact on sleep among pre-schoolers [9].

The aim of this study was to systematically review the literature on the impact of using electronic media on sleep in children and adolescents. The population was pre-school children, school-age children up to 12-years-old and young adolescents up to 15 years old. The exposure was access to and use of electronic media devices, and the outcomes were bedtime and sleep onset, sleep quality during nighttime, sleep duration and daytime tiredness. The intention was to inform policy and practice and to highlight what further research is needed on this topic.

Methods

Eligibility criteria

We included studies which fulfilled the following eligibility criteria: (1) Assessed the associations between the use of or access to electronic media devices and sleep, i.e. delayed bedtime, sleep onset latency, sleep quality during night-time, sleep duration and daytime tiredness; (2) Published in English between January 1, 2009 and August 31, 2019; (3) From western countries; (4) Examined children and adolescents between 0 and 15.9 years of age without any diagnoses/diseases. Electronic media devices were defined as mobile phones, televisions, touchscreens/tablets, computers, or video game consoles. The exclusion criteria were apps intended to treat sleep disorders, or problems (e.g., sleep apnoea), and studies examining electromagnetic radiation.

Data sources and search strategy

The PICo model was used to generate the search strategy, and the search strategy was divided into three search blocks: P (Patient / Problem / Population), I (Phenomenon of interest), and Co (Context). The population was children and adolescents aged 0-15; the field of interest was electronic media devices, and the context was before sleep (bedtime and sleep onset), during sleep (sleep quality during nighttime), and after sleep (sleep duration and daytime tiredness). We performed a systematic search in four databases: CINAHL, EMBASE, Web of Science, and Medline based on keywords (subject headings/MeSH terms) and free text searches (title, keywords, text). The search terms and syntax included relevant synonyms for the search terms adolescents/children (e.g. minor, teenager), electronic media devices (e.g. cell phone, screen), and sleep (e.g. sleep latency, bedtime routine) (see Supplementary eTable 1 for the full search in each database). In addition, we included previous reviews to identify relevant studies.

Study selection; screening, quality assessment, and data extraction

Title and abstracts identified were screened for eligibility, and full texts of potentially eligible articles were read and assessed by two reviewers (LL and INS) independently. Discordance regarding inclusion was resolved through discussion. Two reviewers (LL and SA) independently assessed the methodological quality of the included quantitative studies. To ensure consistency in the quality assessments, meetings were held on an ongoing basis, focusing on inter-rater reliability. The methodological quality of the quantitative articles was assessed using the Effective Public Health Practice Project (EPHPP) assessment tool [10], based on the following five components: selection bias, study design, confounders, data collection methods, and withdrawal/dropouts. The EPHPP covers any quantitative study design, it is developed for use within public health and has been found to have psychometric properties as good as the Cochrane risk-of-bias tool. Each study was rated as high, moderate, or low quality. Low-quality studies were excluded to ensure moderate evidence. We extracted the data using a standardized data extraction form. It included country of study, age, sex, study design, sleep outcomes, exposure (electronic media device measures) and reported associations. Synthesis was done by summarizing results and conclusions across studies grouped by age groups of 0-5.9 years, 6-12.9 years, and 13-15.9 years within four sleep domains: Bedtime and sleep onset; Sleep quality; Sleep duration; Daytime tiredness. If a study included data on ages overlapping the defined age categories, we used the mean age to allocate the study to an age category. A few studies (n=3) included a large age span. However, these studies had performed analyses by subgroups of age corresponding to our categories.

Results

A total of 446 full texts were reviewed, of which 338 were excluded (Figure 1). Due to a low number of qualitative studies (n=7), the results from qualitative studies are not reported. In total, 52 quantitative studies were not included because they received a low-quality assessment rating as a result of a range of methodological issues: weakness in study design, a small percentage of responses, not controlling for confounders, and not reporting validity and reliability of measures used. Of the 49 included quantitative studies, four studies received a high-quality assessment rating, and 45 studies received a moderate-quality assessment rating (see Tables 1-3). Of the included studies, 18 were conducted in North America [11-28], 23 in Europe [29-51], five in Australia and New Zealand [52-56], and three studies combined several western countries [57-59]. There were three randomized controlled trials (RCTs) [27, 28, 50], two quasi-experimental studies [26, 51], 15 prospective cohort studies [12, 16, 19, 24, 30, 32, 35, 37, 40, 42, 45, 47, 48, 52, 55], and 29 cross-sectional studies [11, 13-15, 17, 18, 20-23, 25, 29, 31, 33, 34, 36, 38, 39, 41, 43, 44, 46, 49, 53, 54, 56-59]. Detailed descriptions of study design and results are available in Supplementary eTables 2-4.

Electronic media use among children aged 0-5

Table 1 summarizes the results of the 13 studies [11-15, 27, 29-32, 52, 56, 57] included for 0-5-year-olds.

Bedtime and sleep onset

There were two studies on television viewing before bedtime and both found an association with delayed bedtime or sleep onset latency [11, 13]. Two studies estimated the association between mobile phone use and delayed bedtime or sleep onset latency with one finding a positive association for the use of mobile phones at night-time [14] and one finding no association [11]. The association between gaming and delayed bedtime or sleep onset latency was examined in three studies [11, 13, 14] with one study reporting an association [13]. One longitudinal study examined screen time in 2-year-olds and found a positive association with sleep onset latency in 5-year-olds [52]. No evidence was found for an association between computer/Internet use and delayed bedtime/sleep onset [11, 13, 14]. One study found an association between the presence of a television in the bedroom and delayed bedtimes on weekdays, but not on the weekend [13].

Sleep quality

There was no evidence for television viewing or use of touchscreens [29], while there was inconsistent evidence for general screen time use [15, 52, 56] on night awakenings or sleep disturbances. An intervention study showed that promotion of prosocial content on electronic media reduced sleep problems [27].

Sleep duration

Regarding sleep duration, three studies showed that overall screen time was associated with shorter sleep duration [15, 52, 60], and six studies showed this concerning television viewing [11-13, 30-32] and three studies concerning use of touch screen or tablet [11, 14, 29]. Lack of association was found for the use of mobile phones [11, 14], video gaming [11, 13, 14] and computers or Internet [11, 13, 14]. Inconsistent evidence was found for the presence of electronic media devices in the bedroom [12, 13]; for ethnic minority children, television in the bedroom among 4-year-olds was associated with 32 fewer minutes of sleep per day at age 7 [12].

Daytime sleep duration

Three studies found associations between television viewing and longer naps [11, 13, 29], while inconsistent evidence was found for the use of mobile phones [11, 14] and touch screen or tablet [11, 14, 29]. No evidence was found for gaming, computer or internet use, and the presence of electronic media devices in the bedroom [11, 13, 14].

Electronic media use among children aged 6-12

Table 2 summarizes the results for the 15 studies [15-21, 28, 30, 33-37, 53] included for the age range 6-12.

Bedtime and sleep onset

Six studies analysed the association between electronic media use and late bedtime and/or sleep onset [18, 33, 35-37, 53]. Five of the studies found an association. Some studies only found an association when stratified by specific variables such as weekends/weekdays. For example, Mireku et al. (2019) showed that use of screen-based media device in the last hour before bedtime was associated with 1.44 times the odds of delayed sleep onset on weekends, but no association was found on weekdays [36]. Two studies assessed the association between video gaming and sleep onset [18, 33]. Arora et al. (2014) showed that high frequency of gaming at bedtime was associated with a 6.2 minutes prolonged sleep onset on weekdays [33]. Falbe et al. (2015) reported that each hour per day of gaming was associated with a 9.8 minutes later bedtime [18]. Two studies found that electronic media in the bedroom, including mobile phones, televisions, and computers, were associated with later bedtimes [18, 37]. One of the studies, however, only found a significant association among boys, not girls [37]. One study did not find that electronic media devices in the bedroom was associated with sleep latency and trouble falling asleep [33].

Sleep quality

Six of eight studies found a positive association between the use of electronic media, including television and mobile phones, and night-time awakenings/sleep disturbances [15, 33, 35, 53] or poor sleep quality [20, 36]. For example, Mireku et al. (2019) found that using mobile phone or watching television in the dark was associated with restless sleep, waking up at night, and waking early in the morning [36].

Sleep duration

A total of 15 studies were identified, examining the association between electronic media use and sleep duration among 6-12-year-olds [15-21, 28, 30, 33-37, 53]. The studies found use of mobile phone [17, 33, 35, 36], social media [33], and computer or television [17, 18, 21, 30, 33, 36, 37] associated with short sleep duration. Six studies examined the association between electronic media in the bedroom and sleep duration [17, 18, 28, 33, 34, 37]. Among these studies, three found an association. Chahal et al. (2012) showed a dose-response association, where children who had access to more electronic media in their bedroom slept less [17]. Falbe et al. (2015) found that children who slept close to a small screen (e.g., mobile phone) reported 21 minutes less sleep compared to children who did not [18].

Daytime tiredness

Two studies examined mobile phone use and daytime tiredness [35, 53]. Redmayne et al. (2013) found that children disturbed by their mobile phone at night at least once a week were 3.5 times more likely to experience daytime tiredness than children who were not disturbed by their mobile phone at night [53]. Huss et al. (2015) did not find an association [35].

Electronic media use among children aged 13-15

Table 3 summarizes the results of the 24 studies [15, 22-26, 38-51, 54, 55, 58, 59] included in the age range 13-15.

Bedtime and sleep onset

Eleven studies investigated the relationship between electronic media use and delayed bedtime and sleep onset [23, 24, 40, 43, 45, 46, 48-51, 59]. Nine of these studies showed a positive association [23, 40, 43, 45, 46, 48, 49, 51, 59]. High electronic media use was associated with problems falling asleep/later sleep onset [23, 40, 45, 46, 51, 59], delayed bedtime [43, 46, 49] and bedtime problems (e.g. hard to go to bed) [45] The study by Poulain et al. (2019) showed a positive association for high use of computer or Internet (3-4 hours/day or more) and more bedtime problems at 12-month follow-up, while no association was found for television viewing or mobile phone use [45]. Two studies found an association between social media use and delayed sleep onset [46, 48]. Van der Schuur et al. (2019) found that social media stress was longitudinally related to sleep onset latency among girls, but not boys [48]. Scott et al. (2019) found a dose-response relationship between social media use and late sleep onset, where a higher use of social media was associated with higher odds of late sleep onset [46].

Sleep quality

Ten studies assessed the association between electronic media use and sleep quality, including restless sleep, night-time awakenings, and insomnia complaints [15, 40, 41, 44-47, 50, 54, 55] and seven of these studies found a positive association [15, 40, 41, 44, 46, 54, 55]. Three of these studies included measures on social media use [46, 54, 55]. There were indications that a large amount of time on social media or problematic use of social media had an impact on sleep quality [46, 54, 55]. Problematic use of social media was measured by e.g. whether the adolescents preferred spending time on social media rather than engaging in social activities or used social media to feel good about themselves.

Sleep duration

The relationship between electronic media use and sleep duration was examined in 11 studies [15, 22-26, 38, 42, 50, 51, 58, 59]. Mazzer et al. (2018), who examined eighth- and ninth-grade students over a year, found that of electronic media use was associated with short sleep duration [42]. Regarding different types of electronic media, it appears that computers [22, 24, 38, 58], mobile phones [22, 24, 38], and video games [22, 38] affected sleep duration. Brunetti et al. (2016), for example, found that computer use doubled the odds of a short night's sleep, while talking on a mobile phone tripled the odds of a short night's sleep [22]. In contrast, Tavernier et al. (2017) found that talking on the phone increased the sleep duration, whereas texting reduced the sleep duration. In this study, social media use (e.g. Facebook) was not related to sleep duration, whereas Twenge et al. (2017) found an association between social media and short sleep duration. Two studies investigated the presence of electronic media in the bedroom and sleep duration. There were indications that a computer, but not a television or gaming console, in the bedroom negatively affected sleep duration [23, 39].

Daytime tiredness

Eight studies examined the association between electronic media use and daytime tiredness, and found mixed results [22, 40, 45, 47-50, 61]. Poulain et al. (2019) showed that high computer or Internet use, but not television and mobile phone use, resulted in more daytime tiredness [45]. Brunetti et al. (2016) found that computer use and time spent talking on the mobile phone were associated with more daytime sleepiness while no associations were found for videogame time and television use [22]. One study that examined social media showed that using social media was not in itself associated with daytime tiredness, but adverse emotional reactions arising from social media (i.e. social media stress) was related to daytime tiredness among girls [48].

Discussion

This systematic review summarizes results from 49 epidemiological studies on associations between electronic media use and sleep in 0-15-year-old children and adolescents. Across age groups, we found consistent evidence that media use was associated with short sleep duration. For the youngest children (i.e. preschool children), television watching, and tablet device use were associated with awakenings at night and shorter total sleep duration. Moreover, heavier television use was associated with increased daytime napping, which suggests poorer sleep consolidation and less mature sleep patterns [62]. For 6-12-year-old children, use of electronic media devices (in general and at bedtime) and their presence in the bedroom were associated with later bedtimes and shorter sleep duration. Similar results have been reported in a previous systematic review examining the association between portable screen-based media device access or use in the bedroom and sleep outcomes [63]. Additionally, we found evidence that television watching and mobile phone use at bedtime were associated with awakening at night. This supports the hypothesis that evening exposure to bright light from screens may disturb the sleep-wake cycle and suppresses the melatonin production [7, 64, 65]. Other mechanisms through which media use may interfere with sleep onset and sleep problems are time replacement (i.e. time spent on the screens at night displaces time spent sleeping) or the psychological stimulation from the media content [66]. For 13-15-year-olds, use of electronic media devices were associated with shorter sleep duration and other adverse sleep outcomes (e.g., sleepiness and lack of concentration during daytime, and problems with falling asleep). This is in line with a systematic review including 15-24-year-olds [67]. Moreover, we found that social media use was associated with poor sleep quality among 13-15-year-olds. It is suggested that adolescents often use electronic devices for social media, and this may explain the relationship between use of electronic media device and poor sleep [67, 68]. Among the 13-15-year-olds, television watching was least likely to be associated with poor sleep outcomes. Thus, for this age group our study supports that more interactive forms of electronic media with increases in physiological arousal [69] may have greater impact on sleep than more passive forms [7, 70].

Limitations And Future Directions

We noted several limitations in the studies included in this review. Firstly, most of the study designs were cross-sectional which precluded causal inferences. Some children and adolescents may experience bedtime procrastination (i.e. going to bed later than intended despite the absence of external reasons) [71] and use electronic media as an activity before sleep. Others may use electronic media to help them go to sleep [72] or because of tiredness [42]. Such reciprocal associations are confirmed by some of the included studies [42, 45]. Secondly, both self-reported and parent-reported data may be subject to uncertainty. For example, adolescents tend to over-report their sleep duration compared with objective measurements such as actigraphy or diary methods [73], and parents tend to report better sleep for adolescents compared with both self-reported and objective measurements [74]. Thirdly, the included studies were measuring media use and sleep outcomes differently (e.g., overall screen time exposure versus bedtime use). Due to the substantial heterogeneity in measurements of media and sleep as well as in effect size measure, it was difficult to summarize the results, estimate the magnitude of the associations and provide clear conclusions. Nonetheless, we have rigorously outlined the associations between electronic media and each sleep outcome which enables comprehensive results; still, there were several insufficiencies. The studies among 6-12-year-olds lacked measurements of sleepiness during daytime; a factor that may have serious consequences on schoolwork and leisure activities. In the age group of 13-15-year-olds, there was a lack of studies measuring the electronic media use at bedtime or during the night. This is an important area to examine because parental monitoring and parent-set bedtimes decline significantly from early to late years of adolescence [75] which might imply an increase in the use of electronic media devices at bedtime.

Despite these limitations, we note several strengths of this study in addressing the association between electronic media device use and sleep in children and adolescents. First, the studies represented a relatively short period of time which ensured that the definition of electronic media devices remained stable. Secondly, we excluded studies of low quality. Thirdly, we included a broad age group ; children and adolescents from 0 to 15. This broadens our understanding of how the use of electronic media devices may impact sleep in different age groups in a childhood development perspective. However, comprehensive equity reviews on e.g. socio-economic background in the study population and mechanisms would provide a more thorough understanding of the associations. Only a few qualitative studies were identified. This leaves a large gap in understanding the complexities of electronic media device use and sleep relationship in children and adolescents.

Implications for policy and practice

At the policy level, information and more public awareness could be promoted about the potential negative impact on children's sleep of electronic media, if used excessively and immediately before bedtime. In general, this could include renewed awareness and promotion of appropriate sleep hygiene, but also more attention to the potential adverse effects of the seemingly unavoidable increase in the use of electronic media in the everyday life. At the practice level, professionals and caretakers of children and adolescents should have a heightened awareness on sleep and encourage bedtime routines including

calming activities without use of electronic media and remove all electronic media from the bedroom [76]. Given the strong attraction of electronic media on most children, interventions should include both structural measures to guide children's electronic media habits and individual measures focusing on e.g. information about the potential impact of electronic media devices and how to develop healthy media habits.

Conclusions

This systematic review of 49 studies found consistent evidence that use of electronic devices is associated with shorter sleep duration in children and adolescents. The association between electronic media use and other sleep outcomes was more inconclusive. Moreover, the evidence for association between electronic media and sleep was stronger for 6-15-years-olds than 0-5-year-olds.

Abbreviations

N=Number

RCT=Randomized controlled trial

Declarations

Availability of data and materials

All data generated or analyzed during this study are included in this article (and its supplementary files).

Ethics approval and consent to participate

Ethics approval was not required for this review.

Consent for publication

Not applicable.

Competing interest

The authors declare no conflict of interest.

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Authors' contributions

LL and SA designed this study. LL and ISN conducted the database searches and extracted data. LL, ISN and SA analyzed the data. All authors have read, reviewed and approved the final manuscript.

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Tables

Table 1. Summary of studies and their findings on the relationship between electronic media devices and sleep outcomes among 0-5-year-olds

Electronic media device	Measured at bedtime	Sleep outcomes				Quality Assessment
		Delayed bedtime or sleep onset latency	Poor sleep quality	Short sleep duration	Daytime sleep duration/ Daytime tiredness	
Television						
Beyens 2019	No	+		+/0	+	Moderate
	Yes	+		+/0	0	
Cespedes 2014	No			+		Moderate
Cheung 2017	No	0	0	0	+	Moderate
Marinelli 2014	No			+		Moderate
McDonald 2014	Yes			+		Moderate
Moorman 2019	No	0		+	+	Moderate
	Yes	+		+	0	
Plancoulaine 2018	No			+		Moderate
Video game (console)						
Beyens 2019	No	0		0	0	Moderate
	Yes	0		0	0	
Moorman 2019	No	+		0	0	Moderate
	Yes	+		0		
Nathanson 2018	No	0		0	0	
	Yes	0		0	0	Moderate
Mobile phone						
Beyens 2019	No	0		0	+/0	Moderate
	Yes	0		0	+	
Nathanson	No	0		0	0	Moderate

2018	Yes	+		0	0	
Touchscreen/tablet						
Beyens 2019	No	+		+/0	+	Moderate
	Yes	+		+/0	+/0	
Cheung 2017	No	+	0	+	0	Moderate
Nathanson 2018	No	+		+	0	Moderate
	Yes	+		+	0	
Computer/internet						
Beyens 2019	No	0		0	0	Moderate
	Yes	0		0	0	
Moorman 2019	No	0		+/0	0	Moderate
	Yes	0		0	0	
Nathanson 2018	No	0		0	0	Moderate
	Yes	0		0	0	
Total screen time						
Parent 2016	No		+	+		Moderate
Ribner 2019	No			+	0	Moderate
Xu 2016	No	+	-	+		Moderate
Zhang 2018	No		0	0		Moderate
Electronic media devices in the bedroom						
Cespedes 2014				+/0		Moderate
Moorman 2019		+		0	0	Moderate
Content						
Garrison 2012	No		+			Moderate

Note: 1st author and year. (+) Significant positive association; (0) No association; (-) Significant negative association; (+/0) refers to both a positive association and no association in different subgroups

Table 2. Summary of studies and their findings on the relationship between electronic media devices and sleep outcomes among 6-12-year-olds

Electronic media device	Measured at bedtime	Sleep outcomes				Quality Assessment
		Delayed bedtime or sleep onset latency	Poor sleep quality	Short sleep duration	Daytime tiredness	
Television						
Arora 2014	Yes	0	+	+		Moderate
Chahal 2012	Yes			+		Moderate
Falbe 2014	No	+		+		Moderate
Marinelli 2014	No			+		Moderate
Mireku 2019	Yes	+	+	+		Moderate
Nuutinen 2013	No	+		+		Moderate
Yland 2015	No			+		Moderate
Video game (console)						
Arora 2014	Yes	+	+	+		Moderate
Chahal 2012	Yes			+		Moderate
Falbe 2014	No	+		+		Moderate
Yland 2015	No			0		Moderate
Mobile phone						
Arora 2014	Yes	+/0	+	+		Moderate
Chahal 2012	Yes			+		Moderate
Huss 2015	No	+	+	+	0	Moderate
Mireku 2019	Yes	+	+	+		Moderate
Redmayne 2013	No	0	0	0	+	Moderate
Computer						

Arora 2014	Yes	+/0	+	+	Moderate
Chahal 2012	Yes			+	Moderate
Nuutinen 2013	No	+		+	Moderate
Yland 2015	No			+/0	Moderate
Internet/social media					
Arora 2014	Yes	+	0	+	Moderate
Total screen time					
Barlett 2011	No			+	Moderate
Brambilla 2017	Yes			+	Moderate
Gentile 2014	No			+	Moderate
Greever 2017	No		+	0	Moderate
Mireku 2019	Yes	+		+	Moderate
Parent 2016	No		+	+	Moderate
Electronic media devices in the bedroom					
Arora 2014		0	0	+	Moderate
Brambilla 2017				0	Moderate
Chahal 2012				+	Moderate
Falbe 2014		+		+	Moderate
Mindell 2016				0	Moderate
Nuutinen 2013		+		+/0	Moderate

Note: 1st author and year. (+) Significant positive association; (0) No association; (+/0) refers to a positive association and no association for different outcome measures

Table 3. Summary of studies and their findings on the relationship between electronic media devices and sleep outcomes among 13-15-year-olds

Electronic media device	Measured at bedtime	Sleep outcomes				Quality Assessment
		Delayed bedtime or sleep onset latency	Poor sleep quality	Short sleep duration	Daytime tiredness	
Television						
Arora 2013	Yes			+		Moderate
Brunetti 2016	No			-	0	Moderate
Lange 2015	No		0			Moderate
Poulain 2019	No	0	0		0	High
Tavenier 2017	No	0		0		High
Twenge 2017	No			+/0		Moderate
Video game (console)						
Arora 2013	Yes			+		Moderate
Brunetti 2016	No			+/0	0	Moderate
Lange 2015	No		+/0			Moderate
Tavernier 2017	No	0		0		High
Wallenius 2009	No	+/-			+	Moderate
Mobile phone/smartphone						
Arora 2013	Yes			+		Moderate
Brunetti 2016	No			+	+	Moderate
Foerster 2019	No	+	+/0		0	Moderate
Lange 2015	No		0			Moderate
Poulain 2019	No	0	0		0	High
Tavernier 2017	No	0		+		High
Computer/internet						
Arora 2013	Yes			+		Moderate
Brunetti 2016	No			+	+	Moderate
Lange 2015	No		+/0			Moderate
Nuutinen 2014	No			+		Moderate

Poulain 2019	No	+	0		+	High
Tavernier 2017	No	0		+		High
Twenge 2017	No			+		Moderate
Social media						
Scott 2019	No	+	+			Moderate
Tavernier 2017	No	0		0		High
Twenge 2017	No			+		Moderate
Van der Schuur 2019	No	+			+/0	Moderate
Vernon 2015	No		+			Moderate
Vernon 2017	No		+			Moderate
Total screen time						
Bickham 2018	No			+		High
Calamaro 2009	Yes	+		+	+	Moderate
Das_Friebel 2018	Yes	0	0	0	0	High
Foerster 2019	No	+	0		+	Moderate
Lange 2015	No		+/0			Moderate
Mazzer 2018	No			+		Moderate
Ogunleye 2015	No	+				Moderate
Ononogbu 2014	No		+			Moderate
Parent 2016	No		+	0		Moderate
Perrault 2019	Yes	+		+		Moderate
Twenge 2017	No			+		Moderate
Van der Schuur 2018	No				0	Moderate
Vandendriessche 2019	No	+		+		Moderate
Electronic media devices in the bedroom						
Calamaro 2009				0		Moderate
Continente 2016				+/0		Moderate

Note: 1st author and year. (+) Significant positive association; (0) No association; (-) Significant negative association; (+/0) refers to both a positive association and no association in different subgroups; (+/-) refers to both a positive association and a negative association in different subgroups

Figures

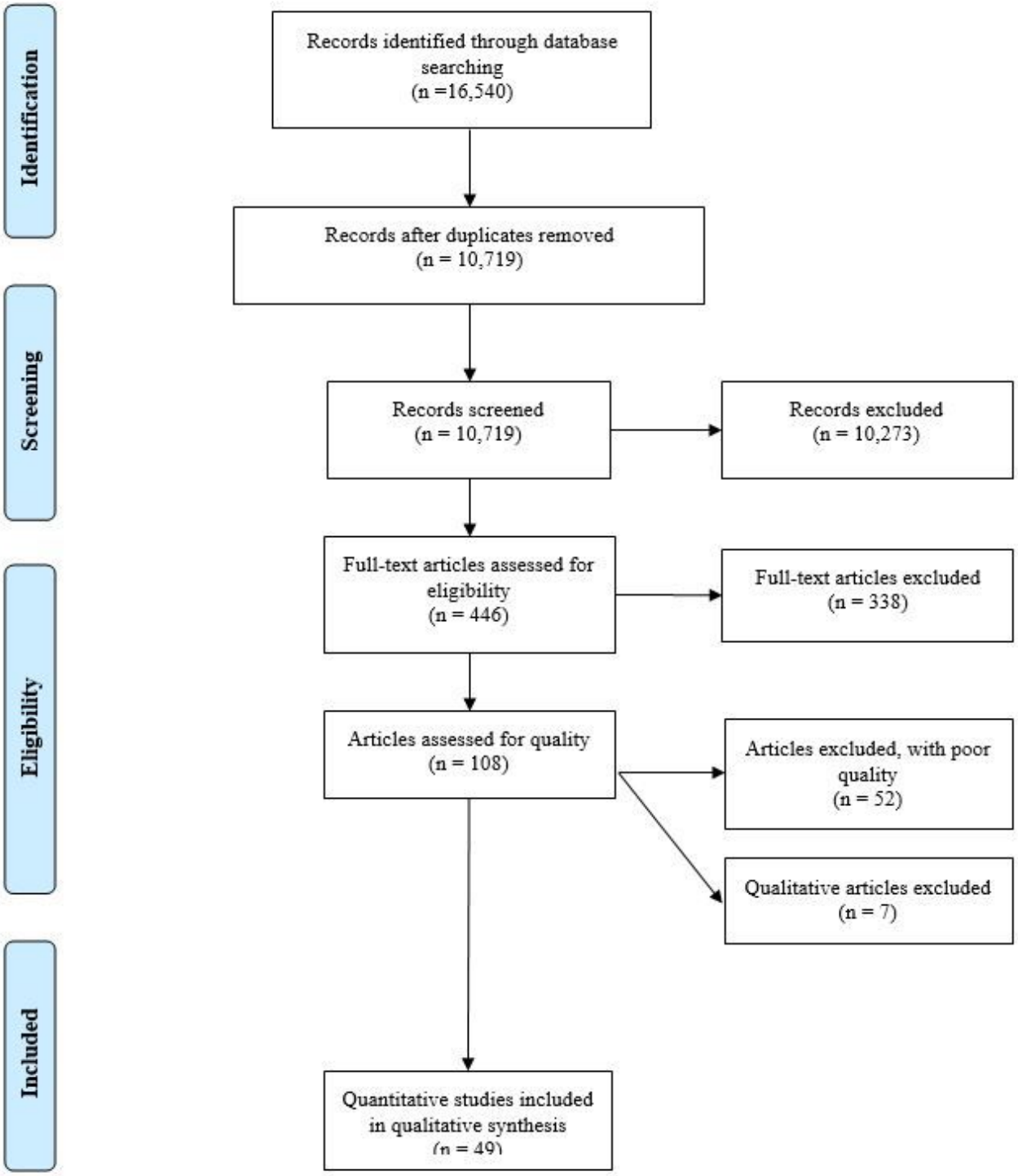

Figure 1

Flow chart of the review process

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PRISMAchecklist.docx
- Suppl.tables.docx