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Association of digital media use with sleep habits in school children: A cross-sectional study

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ABSTRACT

Background: The use of digital media (DM) is increasing among school-children, which can affect their sleep habits. The primary objective of this study was to evaluate the association of DM use with sleep habits in school-children.

Methods: It was a cross-sectional study of healthy school children. Sleep habits and DM use were assessed using the Children's Sleep Habits Questionnaire (CSHQ) and SCREENS-Q, respectively. The Pearson correlation coefficient was used to establish the correlation between the two variables. Logistic regression analysis was performed to quantify the extent of association between variables. A p-value <0.05 was considered statistically significant.

Results: A total of 205 children were enrolled with a mean (SD) age of 7.1 (2.1) years. The mean (SD) sleep duration was 7.58 (0.80) hours. The mean (SD) CSHQ score was 50.6 (5.1). Use of DM was observed in 204 (99.5 %) children. On multivariate logistic regression analysis, DM use ≥2 h/day was significantly associated with higher CSHQ score (OR 1.28, 95%CI 1.18–1.40; p = 0.001). Sleep domains significantly affected by DM use ≥2 h/day were bedtime resistance (OR 1.55, 95 % CI 1.24–1.94; p < 0.001), sleep duration (OR 0.40, 95 % CI 0.28–0.58:p < 0.001), sleep anxiety (OR 1.69, 95%CI 1.40–2.04:p < 0.001), night awakening (OR 4.81 95 % CI 2.98–7.78:p < 0.001), parasomnias (OR 1.86, 95 % CI 1.45–2.38:p < 0.001), and daytime sleepiness (OR1.89,95 % CI 1.52–2.36: p < 0.001). DM use 30 min before bedtime was significantly associated with a higher CSHQ score (OR 1.32, 95 % CI 1.20–1.45; p < 0.001). In bivariate regression analysis, DM use ≥2 h/day was associated with poor academic performance (OR 2.36 95 % CI 1.28–4.35; p 0.006).

Conclusion: This study has shown that the average sleep duration in children was shorter than the recommended duration. DM use was common in school children and it has a significant association with sleep habits especially with use of ≥2 h/day and 30 mints before bedtime. It was also associated with poor academic performance. Public awareness on effect of DM use in school children is the need of the hour.

1. Introduction

Healthy sleep habits are vital for the typical physical and mental health development in children [1]. The typical normal sleep pattern depends on biological, social, behavioral, and environmental factors [2]. The American Academy of Sleep Medicine (AASM) recommends 9–12 h of sleep in school-going children [3]. However, there is a wide regional difference in sleep patterns in children [4,5]. Studies have shown a significant difference in sleep patterns in Asian children compared to Western countries [5–7]. Several factors contribute to this difference, e.g., co-sleeping, mother's employment, family size, sleeping practice (bedtime, wake-up time, daytime sleep, etc.), air pollution, etc. [7], Sleep disturbance is common in all age groups. The estimated prevalence of sleep disturbance in children is 20–40 % [8]. Sleep disturbance in children can lead to many adverse health outcomes, including poor cognitive ability, school performance, cardiovascular, metabolic diseases, and immune dysfunction [9]. In addition, poor sleep habit in children has an association on parents sleep quality [10].

Polysomnography (PSG) is a primary diagnostic test for sleep-related disorders [11]. However, it is not widely available, particularly in poor resource settings, and is also cumbersome to perform. Sleep patterns can be assessed with actigraphy, sleep diary, and questionnaires. Actigraphy provides more objective data, but it lacks specificity in children [11].

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Abbreviation

CSHQ	Children's Sleep Habits Questionnaire
SCREENS-Q:	SCREENS Questionnaire
PSG	Polysomnography
OPD	Out Patients department
IAP	Indian Academy of Pediatrics
AAP	American Academy of Pediatrics
AASM	American Academy of Sleep Medicine
BMI	Body Mass Index
DM	Digital Media

Several validated questionnaires are available to evaluate sleep patterns and disorders in children [12]. The Childhood Sleep Habit Questionnaire (CSHQ) is one of the most widely used validated questionnaires documenting sleep patterns in school-going children [13]. Studies have shown good internal consistency and are adequate for the screening of sleep problems in school children [10,14].

Use of electronic DM use is increasing among school children, even in developing countries and remote areas. It is estimated that more than 45 % of children use DM before they turn one year old. Additionally, it is reported that approximately 75 % of children aged up to 8 years old have access to smartphones [15]. National Sleep Foundation has estimated that 97 % of American adolescents use DM devices in the bedroom, including entertainment gadgets, video games, audio players, mobile, TV, computer, and Internet browsing. Television use has been linked to decreased sleep time, late bedtime, bedtime resistance, and sleep anxiety [16].

There is a paucity of studies on the association of DM use on sleep patterns in school-going children from India. We conducted this study to evaluate the association of DM use with sleep habits in school-children in our population.

2. Methods

It was a cross-sectional study conducted in a tertiary care hospital in western India. Healthy children from 4 to 10 years of age attending the paediatric outpatient department (OPD) for routine check-ups and immunization and who did not have a recent acute respiratory infection in the last 2 weeks were included in this study. Children with acute or known chronic diseases or on medication that can affect sleep were excluded from the study. For, this purpose, a detailed clinical history and examination were performed to exclude any apparent acute or chronic illness. Written informed consent from parents was taken. The institutional ethics committee approved the study.

The primary objective of the study was to assess the association of DM use with sleep habits in children. The secondary objectives were to assess the pattern of sleep habits, the association of sleep habits with academic performance and obesity in children.

We used validated questionnaires translated into the native language (Hindi) in the study. Children's Sleep Habit Questionnaire (CSHQ) was used to assess the sleep habit in children. It is a validated questionnaire and has been validated in different languages [10,14]. It has been validated in Indian children [17]. It is a parents-reported questionnaire consist 33 question items categorized into eight sleep domains viz. bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep-disordered breathing, and daytime sleepiness. Each question item is responded to by their parents on a 3-point scale. It has shown a good internal consistency (Cronbach alpha 0.68). A higher CSHQ score denotes poor sleep habits. At a cut-off score of $\geq$41, CSHQ has shown a sensitivity of 0.80 and specificity of 0.72 [13]. It is an adequate test for the screening of sleep-related problems in school children.

SCREENS-Q is a validated questionnaire, was administered to assess the use of digital media in children. It consists of 19 questions and 92 question items categorized into six domains, viz. screen media environment, child's screen media use, content of media use, early exposure, parental perception of child's media use, and parental media use. Parents have to respond to each item, and the average fill time is 15 min. It has good internal consistency ranging from 0.61 to 0.90 [18]. It is a promising tool to assess digital media use in children. As per the American Academy of Pediatrics (AAP), using the DM for >2 h is not safe for children [16]. In this study, digital media use for $\geq$2 h per day was considered unsafe for the children. The academic performance of children was evaluated through parental reports regarding their child's scholastic achievement in their current grade level. Parents were asked to categorize their child's performance as "good" or "poor." This assessment relied on subjective judgments made by parents to classify their child's academic performance into two distinct categories.

Overweight and obesity were determined according to the Indian Academy of Pediatrics (IAP) growth chart [19].

We took a convenient sample, wherein children visiting paediatric OPD from January 2021 to July 2022 were screened for the eligibility criteria. Once they fulfilled the criteria for being enrolled in this study. The demographic data were taken on case record form and data entered into a Microsoft Excel worksheet. The data were analyzed with STATA 13 software (StataCorp, College Station, TX). Normally distributed data were presented in mean (SD). We used a *t*-test to compare the mean between two groups, while one-way ANOVA was used to compare the mean for more than 2 groups. The Pearson correlation coefficient (r) assessed the correlation between two quantitative variables. Bivariate and multivariate logistic regression models were applied, taking screen time as the dependent variable and other parameters as independent variables to quantify the association between screen times and sleep habits. A p-value <0.05 was considered statistical significance.

3. Result

A total of 357 children were screened from January 2021 to July 2022, and 244 were found eligible for the study; out of them, 205 children completed the study (Fig-1). The mean (SD) age of enrolled children was 7.1 (2.0) years, and 55.6 % were male. Other demographic characteristics of enrolled children are summarized in Table 1.

3.1. Sleep habit in children

The mean (SD) CSHQ score was 50.6 (5.1), and 189 (92 %) children had a score $\geq$41. The mean (SD) scores of different sleep domains are summarized in Supplementary Table 1. Children are afraid of sleeping alone in 29 (14.1 %), struggle at bedtime in 16 (7.8 %), and need parents in the room to sleep in 31 (15.1 %). The mean (SD) sleep duration was 7.58 (0.80) hours. Children fell asleep within 20 min in 100 (48.7 %).

Of that, 112 (54.6 %) children typically sleep for the right amount each day, and 109 (53.1 %) usually sleep for the same duration each day. Sleep anxiety was present in 31 (15.1 %) of children. Nigh awakening was present in 21 (10.2 %) children. Features of parasomnias were observed in 55 (26.8 %) of the children. Only 4 (1.9 %) children had sleep-disordered breathing. Daytime sleepiness was documented in 12 (5.8 %) of children.

3.2. Use of digital media (DM)

The mean (SD) SCREENS-Q score was 43.5 (8.1). DM use for any duration was observed in 204 (99.5 %) children, and 96 (46.8 %) of them used for $\geq$2 h/day. Most children had media at home (204), and only 9 (4.3 %) had their own devices. Of them, 147 (71.1 %) children were using DM every day, and 39 (19 %) children had access to DM at school. Parents of 83 (40 %) children strongly agreed to set up rules for DM use at home, while 110 (53.9 %) parents were of a neutral opinion.

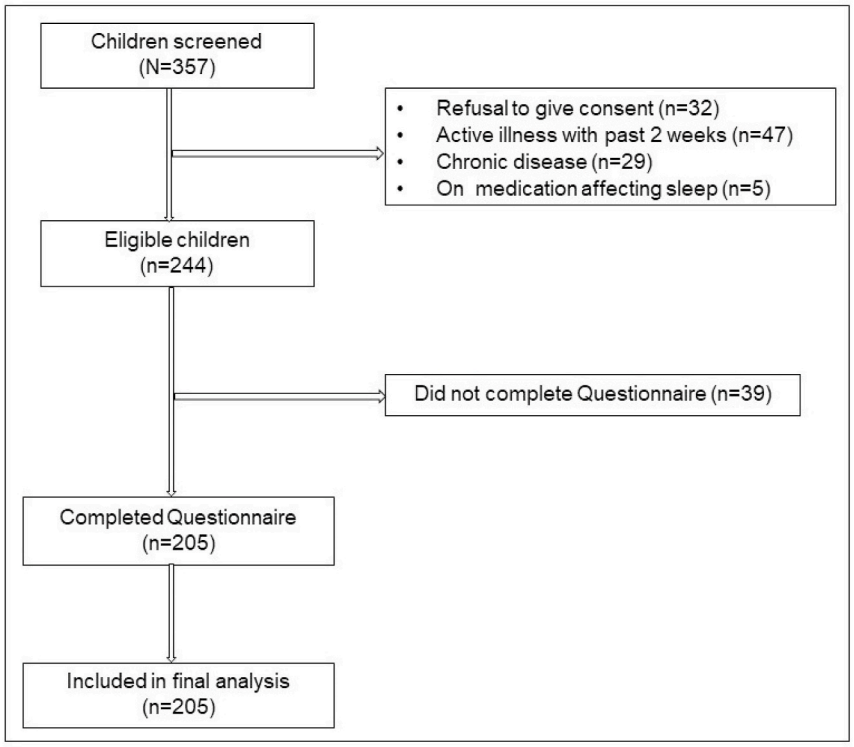

Fig. 1. Flow of study.

Table 1
Demographic characteristics of enrolled children (n = 205).

Characterises	Number (%)
Age (years), Mean (SD)	7.1 (2.0)
Gender	
Male	114 (55.6)
Female	91 (44.4)
Residence	
Urban	113 (55.1)
Rural	92 (44.8)
Anthropometry, Mean (SD)	
Weight (kg)	20.1 (5.9)
Height (cm)	115.6 (11.9)
BMI(kg/m2)	15.4 (2.7)
Children's Academic Performance	
Good	138 (67.32)
Poor	67 (32.6)
Parents Education Status	
Graduate	21 (10.2)
Intermediate	59 (28.7)
High school	112 (54.6 %)
Illiterate	13 (6.3)
Socioeconomic status	
Upper	20 (9.7)
Middle	150 (73.1)
Lower	35 (17.1)

The use of DM 30 min before bed was noted in 138 (67.32 %) children.

3.3. Correlation between DM use and sleep habits in children

There was a linear correlation between CSHQ and SCREENS Q scores. The Pearson correlation coefficient (r) was 0.69 with a p-value of <0.0001 (Fig. 2).

3.4. Association between DM use and sleep habits in children

The mean (SD) CSHQ score was statistically higher in children using

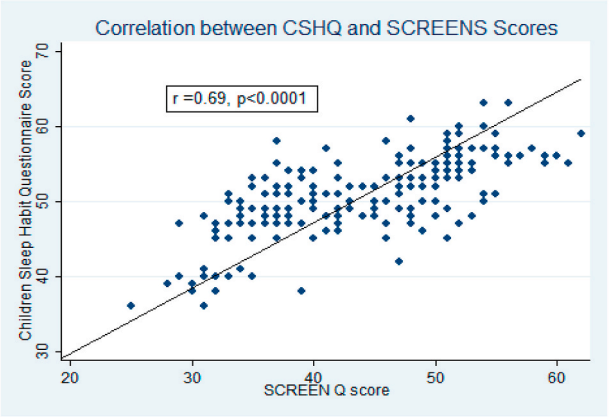

Fig. 2. Correlation between CSHQ score and SCREENS-Q scores.

DM for ≥2 h/day than those who use <2 h/day [53.1 (3.9) vs. 48.5 (4.9); p < 0.001]. On multivariate regression analysis, DM use ≥2 h/day was significantly associated with increased CSHQ score (OR 1.28, 95%CI 1.18–1.40; p = 0.001) (Table 2).

Furthermore, the mean (SD) CSHQ score was significantly higher in children using DM 30 min before bed than those who did not [52.3 (4) vs. 47.1 (5.2); p < 0.001] (Fig. 3) On bivariate regression analysis, DM use 30 min before bedtime was significantly associated with higher CSHQ score (OR 1.29, 95 % CI 1.18–1.41; p < 0.001). On Multivariate regression analysis, the association remained statistically significant (OR 1.32, 95 % CI 1.20–1.45; p < 0.001). The mean (SD) SCREENS-Q score was statistically higher in children who took nap in compared to children who did not take naps (Fig. 4). On multivariate regression analysis, DM use ≥2 h/day was significantly associated with bedtime resistance (OR 1.55, 95 % CI 1.24–1.94; p < 0.001), Sleep duration (OR 0.40, 95 % CI 0.28–0.58: p < 0.001), Sleep Anxiety (OR1.69, 95%CI 1.40–2.04:p < 0.001), Night awakening (OR 4.81 95 % CI 2.98–7.78:p

Table-2
Logistic regression analysis between prolonged media use (≥2 h/day) and other variables.

Parameters	Bivariate analysis		Multivariate analysis	
	Unadjusted odd ratio (95 % CI)	P-value	Adjusted Odd ratio (95 % CI)	P-values
CSHQ score	1.27 (1.17–1.38)	<0.001	1.28 (1.18 (1.40)	<0.001
Academic performance (poor)	2.36 (1.28–4.35)	0.006	1.85 (0.91–3.75)	0.08
Age (year)	1.11 (0.96–1.27)	0.12	1.25 (1.05–1.48)	0.009
Sex (male)	0.75 (0.43–1.3)	0.30	0.94 (0.48–1.82)	0.85
Body mass index	0.98 (0.88–1.08)	0.73	0.93 (0.82–1.05)	0.26
Socio-economic status	0.78 (0.58–1.03)	0.85	0.78 (0.52–1.15)	0.21
Parents education	1.16 (0.94–1.44)	0.15	1.07 (0.81–1.42)	0.59

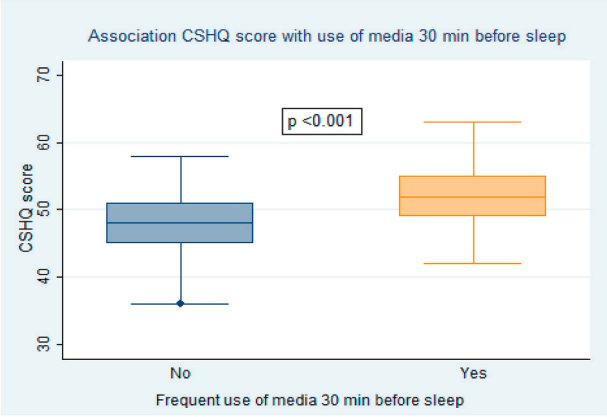

Fig. 3. Association of CSHQ score with the use of digital media 30 min before sleep.

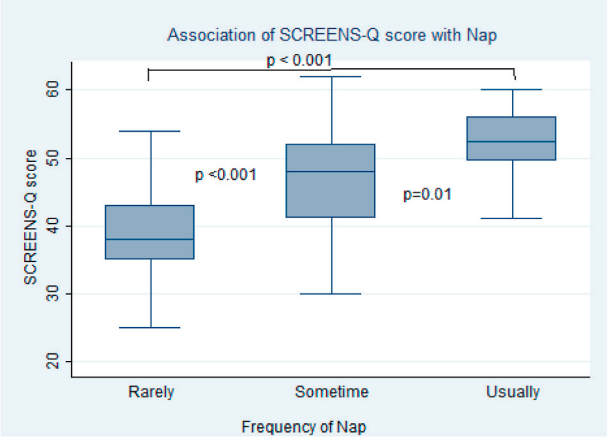

Fig. 4. Association of SCREENS-Q score and nap in children.

< 0.001), parasomnia (OR 1.86, 95 % CI 1.45–2.38:p < 0.001), and daytime sleepiness (OR1.89,95%CI 1.52–2.36: p < 0.001) (**Supplementary Table-2**).

3.5. Association of poor sleep habits on academic performance

Parents reported good academic performance in 67 (32.7 %) children, while poor performance in 138 (67.3 %). The mean (SD) CSHQ score was significantly higher in children with poor academic performance compared to children with good performance [51.4 (4.5) vs. 49.1 (5.8); p = 0.001]. In bivariate regression analysis, DM use ≥2 h/day was associated with poor academic performance (OR 2.36 95 % CI 1.28–4.35; p = 0.006); however, similar significance was not observed in multivariate analysis (Table 2).

3.6. Association of sleep habits with obesity

The mean (SD) BMI was 15.4 (2.6) kg/m2, and only two children were obese. Therefore, this association could not be analyzed.

4. Discussion

In this study, the majority of children had poor sleep habits. DM use in children was a prevalent condition; about half of them use it for ≥2 h/per day. There was a statistically significant association between DM use and poor sleep habits in children. It affected almost all the sleep domains. In addition, children using DM 30 min before going to sleep significantly associated with poor sleep habits. Children with increased exposure to DM were found to have an increased frequency of naps. DM use also has a significant association with poor academic performance of children.

Though PSG is the gold-standard test for diagnosing sleep problems, it is costly, not readily available in developing countries, and very cumbersome to perform [11]. Various validated questionnaires can be used for the assessment of sleep habits in children, viz. Children's Sleep Habits Questionnaire (CSHQ), Paediatric Sleep Questionnaire (PSQ), Tayside Children's Sleep Questionnaire (TCSQ), etc. CSHQ is widely used to assess sleep habits in school children and has been validated in various regional languages [8,10,14]. It has been also validated in Indian children and found to have good overall internal consistency [17]. The Hindi version of CSHQ was also used in this study to evaluate sleep habits in children.

In this study, we observed that most of the children had poor sleep habits. Studies from Western countries observed that 25–50 % of preschool-aged children and 37 % of school children experience sleep difficulties [20]. A study from India, sleep-related disorder was observed in 42.7 % of children from 3 to 10 years [21]. Another study has shown that night time sleep duration is lower in Indian children than the other population [22]. In a study by Yerra A et al., 46.4 % of children had one or the other form of sleep-related problems [23]. In another study from Germany, a 15–44 % prevalence of sleep problems in children [24]. Nevertheless, it's imperative to recognize the profound influence of cultural factors on sleep behaviors. Variations in rituals, co-sleeping practices, bed-sharing customs, cultural beliefs, privacy norms, and overall sleep environments can significantly shape sleep patterns across different cultural contexts. Acknowledging these cultural nuances is crucial for comprehensively understanding sleep health among diverse populations.

The optimum duration of sleep varies in different geographical area. The AASM recommends daily 9–12 h of sleep for children 6–12 years for good health [3]. However, studies have shown a marked cross-cultural difference in sleep habits. A systematic review observed earlier bedtime, earlier wake-up time, and longer duration of sleep in children from Europe, Australia and North America in comparison to children from Asian and Middle East countries. A marked cultural difference in sleep duration and disturbance among these regions were also noted [7]. Another systematic review showed that Asian children sleep 1 h less compared to children from Caucasian and non-Asian countries [2]. Furthermore, a study noted bed-sharing was 83.2 % in Vietnam while it was only 5.8 % in New Zealand. They also observed that Asian children had later bedtime and shorter sleep duration than Caucasian population, however, they did not find a significant difference in daytime sleep [25]. The possible reasons for cross-cultural differences in sleep habits are different rituals, co-sleeping or bed-sharing, beliefs, practices, privacy, physical activity, psychological well-being that correlate with sleep duration and disturbances sleep environment [2,7,25]. The best

example of cultural difference in sleep habit is sleeping arrangement. Sharing Bed and/or room that actually reflect family interdependence, is significantly common in Asian countries in comparison to Caucasian population [25]. Furthermore there are inherent difficulties in doing research on cross-cultural difference in sleep practice. As most of these studies are questionnaire based, which itself has reporting biases in reporting sleep practice. Moreover parent's education status, rural vs. urban area in different culture will also impact the study findings. Therefore the cross-cultural difference in sleep practice across the globe is not straightforward rather it appear a complex phenomenon in which biological and environmental factor too play an important role in determining sleep practice. Some countries like India itself has vast cultural differences in different part of the country that further challenge an accurate estimation of cross-culture difference. We also observed, the mean sleep duration in school children was lesser than the recommended duration. Like other Asian countries, whether these children are actually sleeping for less duration (sleep deprivation) or have less sleep requirement that need to be answered.

In the last decade, DM use has been increasingly common among children especially after the COVID-19 pandemic. DM usage among children is widespread and it ranges from 68 % to 95 % [16]. A study has shown consistent association between poor sleep and DM use in children [26]. Several factors may determine the deleterious effect of DM use on child health, and it include duration of media use, type of device, content, family environment, exposure at school, local policy, etc. However, depending up on the content and activity involved it could also be beneficial and not necessarily harmful [27]. The association between DM use and sleep habit can be assessed using questionnaires like the digital-screen exposure questionnaire (DSEQ) or SCREENS-Q questionnaire [18,28]. In this study, SCREENS-Q was used to assess the children DM use. It is consider as a comprehensive tool which screen family environment and possible correlate apart from screen habit in children. It is a validated tool that classified into 6 domains viz. screen media environment, child screen media use, content of media use, early exposure, parental perception of child media use and parental media use. It includes 19 questions with 72 items and they have moderate to substantial test-retest reliability [18]. In a cross-sectional study using SCRENS-Q, researcher observed that children using DM for >2 h associated with poor language development. Interestingly, they also observed that the children use DM for less duration if they watch with parents or sibling or parents themselves use less media [29]. On the contrary, a study observed that time on DM by itself has a very little effect on the sleep in children, however sleep environment significantly affect the sleep [30]. These study emphasize that DM use beyond certain limit has deleterious effect on child health including poor sleep, however, screen time is not the only factor that influences sleep rather than other factors like content of the media, using with parents or siblings, sleep environment, parental use of media, socio-cultural factors etc. Therefore, further study is warranted considering all these factors for better understanding of media use on sleep in children.

The optimum duration of DM use that is safe for children is still debatable. The American Academy of Pediatrics (AAP) recommends less than 1–2 h/per day of media use in children [3]. Many studies have shown that the use of DM $\geq$ 2 h/day in school children increases the risk of poor school performance [31,32]. Moreover, World Health Organization (WHO) recommends no more than 1 h of screen time in young children (<5 years) [33]. Garrison M et al., who studies DM use on sleep patterns, found that each additional hour of media use increases the odds of sleep problems in children [34]. Though our study observed that children using DM for $\geq$2 h/day had higher odd of poor sleep habit (higher CSHQ score), the median CSHQ score was higher (>41) in both group of children using DM either for $\geq$2 h or < 2 h per day It implies that sleep habit not only depends up on utilization time, it also depend upon several other factors including type of activity and device, socio-cultural practice, dysfunctional use of media, content, family environment, exposure at school, local policy, etc. [26] Therefore, further longitudinal study is required to delineate impact of duration of media use on children sleep habit.

The index study observed that DM use affecte all sleep domains, except sleep onset delay and sleep disorder breathing. In a cross-sectional study of school children, the author noted bedtime resistance in children who had a habit of television watching [35]. In another cross-sectional study, authors demonstrated that media consumption was associated with later bedtimes, later wake-up times, and shorter sleep duration on weekdays and weekends in Chinese school-age children. Overall, bedtime and waking times sleep length on weekdays, sleep disorders of bedtime resistance, and sleep anxiety were the most association sleep behaviors [36]. In a systematic review of 49 studies, there was evidence linking the use of electronic media with later bedtimes and worse sleep quality; screen time leads to difficulty in falling asleep [37].

The mechanism of how DM use associated with poor sleep in children is not yet fully known. In a recent systematic review, the plausible mechanism suggested were time displacement (time used on media compensated by time for sleep and other activity), psychosocial stimulation (content of the media may stimulate the children), sleep disruption (continuous notification from the media), blue light emitted from the device may suppress the melatonin secretion, overstimulation of child, higher number of device etc. [26] Another meta-analysis observed that type of activity, utilization time and dysfunctional use of media may have impact on poor sleep and overall well-being [27]. A study in 9–11 years old child observed that higher number of screen was positively associated with more screen time, low sleep efficiency and higher adiposity [38]. There is increasing interest on effect of light emitted from device on children sleep. Most device emit light usually of short wavelength blue light, that is most effective in suppressing release of melatonin results in change in circadian rhythm that lead to insufficient sleep in children. In an experimental study author observed children are melatonin suppression is twice more sensitive children in comparison to adult [39]. However, most of the available information is from observation studies which limit our understanding on causation between digital media use and sleep insufficiency. Moreover, most of the available studies are questionnaire based which itself has their own limitation. Therefore, a well-designed longitudinal study is warranted to delineate the mechanism of effect of digital media use on sleep and other health outcomes. In this study, we found that increased DM use was also associated with an increased frequency of naps in children. In a study, including 2068 preschool children irregular naptime routines and irregular bedtime schedules were linked to the number of hours of Television viewed each day [40]. In another study in 1843 children 10–12 years old noted higher daytime sleepiness scores in children who spent $\geq$2 h computer or talk on the phone [41]. These study findings support our observation that excessive media is associated with daytime sleepiness.

Use of DM before bedtime is much more prevalent. In our study, children who used DM 30 min before bed had significantly associated with higher CSHQ scores. In a study, 60 % of American children use media before bedtime [42]. A study by Paolo B et al. in children (1–14 years) observed that 63.5 % of children used video device before sleeping. They also noted that video device was a negative predictor of sleep duration [43]. Similar evidence was seen in the study by Beyens et al., which shows bedtime media use leads to sleep disturbances [44]. These studies' findings support our observation that the use of digital media 30 mints before sleep associated poor sleep quality.

Studies have shown that poor sleep habit also influences academic performance. In a meta-analytic review, poor sleep quality, insufficient sleep, and sleepiness were significantly associated with worse school performance [45]. In an adolescent study, a significant association between poor sleep quality and low academic achievement was observed [45]. Similarly, in our study, poor sleep hygiene was significantly associated with poor academic performance.

There are pieces of evidence suggesting poor sleep is an unfavorable

outcome on physical health, including obesity. It was observed that late bedtimes increased the risk of obesity, short sleep, and being overweight and the result was similar in children and adolescents [15]. We found only two children having BMI in the range of obesity. Therefore we did not assess the association of poor sleep habits on obesity. In a developing country, nutritional factors, lifestyle, and poor socioeconomic status predispose to a lack of adequate nutrition rather than obesity, which could be a reason for less obesity in enrolled children.

The major strength of our study is that we used validated questionnaires. Both CSHQ and SCREENS-Q are validated questionnaires. Secondly, we included only healthy children in this study. There were also a few limitations of this study. First, there could be the possibility of parents' memory bias when filling out the questionnaire. Adding some objective criteria like actigraphy or smart watches could bring more objectivity. However, this study did not include these facilities due to poor resources. Second, it was a cross-sectional study with a relatively small sample size. A prospective cohort study with a large sample size could be the best one; however, poor resources were the limiting factors in conducting such a study.

In conclusion, poor sleep habits are common in school-children. DM use is significantly associated with poor sleep habits, especially with prolonged use ($\geq$2 h) and use of DM 30 min before bedtime. The use of DM is also significantly associated with poor academic performance. The study findings emphasize that there is a need to increase public awareness about the use of digital media in schoolchildren.

Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Funding

None.

Conflict of interest disclosure

None of the authors has to disclosed.

Ethics approval statement

The study was approved by the institute ethics committee (AIIMS/IEC/2021/3488).

Patient consent statement

Written informed consent was taken from all the parents/caretakers.

Permission to reproduce material from other sources

Not Applicable.

Clinical trial registration

Not Applicable.

CRediT authorship contribution statement

Doreswamy Chandranaik: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation. **Jagdish Prasad Goyal:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Data curation, Conceptualization. **Kuldeep Singh:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Prawin Kumar:** Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleepx.2024.100117.

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