Sleep Problems and Their Associations with Digital Screen Exposure Among 2 to 5 Years Old Children in Chandigarh, a North Indian Union Territory

Nimran Kaur¹, Madhu Gupta¹, Tanvi Kiran¹, Prahbhjot Malhi² and Sandeep Grover³

Abstract

Background: Watching television and other electronic devices can adversely affect children’s sleep. This study aims to ascertain the association of sleep problems with digital screen exposure (DSE) among 2- to 5-year-old children in Chandigarh, India.

Methods: A cross-sectional study was conducted among 400 randomly selected families having 2- to 5-year-old children, using a validated DSE questionnaire and the standard child’s sleep habits questionnaire abbreviated, from October 2017 to March 2018. The American and Indian Academy of Pediatrics guidelines were used to define higher DSE as more than 1 h per day. The multivariate binary logistic regression analysis was performed using IBM SPSS Statistics for Macintosh, Version 26.0 (IBM Corp., New York, USA), to identify significant predictors of sleep problems.

Results: Boys (51.5%) and girls (48.5%) were equally represented. On average, children (3.5 ± 0.9 years) slept for 10 ± 1.6 h per day. Bedtime sleep resistance (15.1% vs 11%) and sleep behavior problems (11.8% vs 5.6%) were significantly (P < .05) higher among children with higher DSE than children having DSE of less than 1 h per day. The significant predictors of sleep problems were children living in a nuclear family (adjOR = 2.4, CI [1.1, 5.3]), watching non-educational digital media content (adjOR = 2.6, 2.36, CI [1.1, 6.2]), and absence of digital media rules at home (adjOR = 3.9, CI [1.3, 12]). In the subgroup analysis, children having higher DSE (adjOR = 2.4, CI [1.1, 4.9]) had a significantly greater probability of bedtime resistance, and those living in a nuclear family (adjOR = 1.7, CI [1.1, 2.7]) had a significantly greater probability of morning waking-up problems.

Conclusion: Sleep problems were significantly associated with higher DSE among young children in Chandigarh, India.

Keywords
Sleep behaviors, digital screen exposure, screen-time, sleep problems, sleep duration

Introduction

Adequate sleep is critical for day-to-day functioning and mental and physical well-being. Digital screen exposure (DSE), including television (TV) viewing or other digital screens, can cause sleep problems, especially among young and vulnerable children.¹ These sleep problems and the DSE might have further increased significantly during the COVID-19 pandemic because of lockdowns, closure of open spaces for outdoor activities, school closures, and online learning modes. Several sleep problems are associated with impaired cognitive functioning, learning, attention, and poor school performance.²

There are reports of a significant association between using electronic media in bed before going to sleep and sleep behaviors and problems among 1 and a half to 3-year-old children.³ Vandewater et al (2005) reported that 35% of American children (0 to 6 years) live in homes where the

¹Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India
²Department of Pediatrics, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India
³Department of Psychiatry, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India

Corresponding author:
Madhu Gupta, Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh 160012, India.
E-mail: madhugupta21@gmail.com

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TV was switched on in the background while they play. A TV switched on in the background and uncontrolled digital media content, directly and indirectly, affects a child’s sleep behavior. A Spanish study conducted among 2 to 4 and 6 to 9-year-olds reported that every hour per day of TV viewing decreased sleep duration and led to lower well-being among children. As TV viewing adversely influences the balance of biological, psychological, and sleep mechanisms, there has been a global increase in sleep problems among children aged 6 to 8.

TV viewing lessens parents’ engagement with their children and makes them more vulnerable to digital media content, eventually leading to sleep problems. This reduced parent-child interaction might lead to multiple adverse health and behavioral outcomes. The social and physical environment at home could increase DSE among children. Although the Indian Academy of Pediatrics, 2020, and American Academy of Pediatrics, 2016, recommend only 1 h per day of age-appropriate, interactive digital media exposure for a 2 to 5 years old child under adult supervision, 6 in 10 Indian children (2 to 5 years old) have been found to have DSE higher than that recommended for their age in a study. The associations of sleep problems with DSE are unexplored among young children, especially in India. This paper presents the findings on the prevalence of sleep problems and their association with DSE. The results of this study might be helpful to guide future research, especially in the Southeast Asian Region and formulate clinical practice guidelines or recommendations for safe and healthy digital media usage among young children.

Methods

A cross-sectional study was conducted among 400 children aged 2 to 5 years old in Chandigarh, a Union Territory in the north of India from October 2017 to March 2018. The sample size “n” was calculated using the formula “n = 4pq/L^2,” where “p” is the prevalence and assumed as 50% of higher DSE, “q” is “p-1,” and “L” is the precision assumed 8. We had assumed a nonresponse rate of 15% and design effect of 2 to counter cluster effect to have a final sample size of 360. Nearly 48 families (12%) refused to participate in this study during household visits. As we had estimated the sample assuming a nonresponse rate of 15%, hence refusal rate was being taken care of at the time of sample size calculations. Also, we recruited more (n = 400) participants than the calculated sample size (n = 360).

A multistage cluster random sampling technique was used to select the households/families from the study area. A cluster was assumed to be a catchment area catered to by an auxiliary nurse midwife (ANMs) in Chandigarh. Generally, she caters to a population of 4000 to 10,000. The list of all the ANMs (n = 219) enrolled under the Reproductive and Child Health (RCH) program in Chandigarh was obtained from the program officer. In the first stage, we selected 10 such clusters (9 urban and 1 rural) to represent Chandigarh’s population as per probability proportion to size by a simple random sampling technique through generating random numbers on Microsoft Excel, version 2019. The first 9 clusters of ANMs for urban and 1 rural cluster were chosen. In the second stage, the annual health registers of the selected ANMs were obtained to identify and list the households with a 2-to-5-year-old child in their catchment area. 36 households from this list were selected by simple random sampling from each cluster to meet the desired sample size by computer-generated random numbers. If a family was not available, they were contacted over the phone and revisited if they had given consent to participate in study. Eligibility criteria were family having at least 1 electronic device. Each family was visited at their homes to obtain data from the principal caregiver of the child. The younger child was recruited from families with 2 or more children. Only children previously diagnosed with long-term or chronic, or congenital illnesses were excluded. The detailed methodology of the study has been described elsewhere.

Data Collection Methods

The lead author visited the selected household and interviewed the primary caregivers of the children face-to-face by using the following questionnaires.

Digital Screen Exposure Questionnaire (DSEQ)

A validated, pretested, semi-structured, and bilingual (in English and Hindi) DSEQ was used to assess the DSE duration and behaviors. The DSEQ had good internal consistency (Cronbach’s α = 0.73-0.82) and good interrater agreement (Kappa 0.75, 95% CI [0.72, 0.78]). DSEQ was also used to obtain background information from the primary caregivers of the children, media rules at home, media literacy of the parents, and level of physical activity. The information regarding the digital media content watched by the children was obtained by asking 12 questions included in the pretested and validated digital screen exposure questionnaire (DSEQ). It was segregated into educational and non-educational digital media content. Educational content included using media devices for completing homework assignments, learning poems, rhymes, ABC, etc, learning math, numbers, tables, to recognize shapes/sounds/colors, to learn letters, words, vocabulary, language, to draw, write, to watch stories, etc. Non-educational media content included video calling applications to talk to family/friends, watch adult programs (soap opera, news, sports, movies, etc), and watch random things for enjoyment (music, advertisements, baby TV, click photos, etc).

Child’s Sleep Habits Questionnaire-Abbreviated (CHSQ-A)

A standard Child’s Sleep Habits Questionnaire-Abbreviated (CHSQ-A) version was used for measuring the child’s sleep
problems. It was validated in Asian settings and comprised of 22 items. The items of the questionnaire are rated on a 5-point Likert-type scale where “always” signifies a sleep problem that occurred 7 times in the past week, “usually” if the behavior occurred 5 to 6 times in the past week, “sometimes” for 2 to 4 times that week, “rarely” for 1 time that week, and “never” for zero times that week.

**Data Management and Analyses**

The statistical analyses and management were done using the IBM SPSS Statistics for Macintosh, version 25.0. The list of dependent and independent variables and analyses performed is presented in supplementary Table S1.

The cumulative DSE was calculated from all electronic devices viewed by the child separately on weekdays and weekends, as the child’s DSE is different on the weekdays and weekends. We calculated the average DSE per day in minutes based on the weighted DSE average of the weekday (5 weekdays [Monday to Friday]) and weekend (2 weekend [Saturday and Sunday]) using the formula:

\[
\text{Average DSE per day (minutes)} = \frac{([\text{Weekday DSE in minutes} \times 5] + [\text{Weekend DSE in minutes} \times 2])}{7}
\]

We considered DSE for 2 to 5 years old children to be of more than 1 h per day as high level, based on the Indian Academy of Pediatrics guidelines, 2016. The average DSE of children was 1.9 h per day.

**Ethical Considerations**

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**Results**

**Background Characteristics**

The mean age of the children was 3.5 (SD ± 0.9) years old. The boys (51.5%) and girls (48.5%) were almost equally represented in this study. A majority (55.8%) of the families belonged to the higher socioeconomic status, and mostly (56%) lived as nuclear families. The TV was mostly (80%) placed in the parents’ bedroom. Almost all the children (97%) were co-sleeping with their parents at home. More than half (53.8%) of the families kept the TV switched on while the child played or slept in the room (Table 1). In 95.3% of cases, mothers provided data, and in 4.9% cases, by fathers, grandparents, or paternal aunts.

**Prevalence**

**Sleep Problems**

The prevalence of total nighttime waking-up problems was at 23.8%, total morning waking-up problems at 23.3%, total bedtime resistance at 11.8%, total sleep behavior problems at 9.3%, and total sleep problems was at 7.8% Figure 1. The average sleep duration of the children was 10 ± 1.5 h per day.

**DSE**

About 59.5% of children watched TV for more than 1 h (high level; Table 1). The average DSE was 1.9 h per day (interquartile range = 0.6-2.6).
Table 1. Background Characteristics of the Children

| Characteristics of the Children | Mean       | –         |
|---------------------------------|------------|-----------|
| Mean age of the children in years | 3.45       | SD 0.9    |
| Average DSE in hours per day    | 1.9        | IQR 0.6-2.6 |
| Sleep duration in hours per day | 10         | SD 1.5    |
| —                               | Total (N = 400) | Percentage (%) |
| Sex of the child                | –          | –         |
| Boys                            | 206        | 51.5      |
| Girls                           | 194        | 48.5      |
| Age of the child                | –          | –         |
| 2 to 3 years                    | 167        | 41.8      |
| 3 to 4 years                    | 109        | 27.3      |
| 4 to 5 years                    | 124        | 31        |
| Socioeconomic status*           | –          | –         |
| Higher (above $393)             | 223        | 55.8      |
| Middle and lower (below $393)   | 177        | 44.3      |
| Type of family                  | –          | –         |
| Nuclear                         | 224        | 56        |
| Joint or extended               | 176        | 44        |
| TV switched on in the background while the child is playing there | 215 | 53.8 |
| Digital screen exposure         | –          | –         |
| <1 h per day                    | 162        | 40.5      |
| 1 h to 2 h per day              | 108        | 27        |
| 2 h to 3 h per day              | 60         | 15        |
| >3 h per day                    | 70         | 17.5      |
| Child falls asleep with the following members* | – | – |
| Parents                         | 388        | 97        |
| Other family members            | 12         | 3         |
| Siblings                        | 4          | 1         |
| TV placement*                   | –          | –         |
| Parents’ bedroom                | 320        | 80        |
| Living room                     | 68         | 17        |
| Dining room                     | 9          | 2.3       |
| Other rooms (lobby, child’s bedroom, etc) | 23 | 5.6 |

Note: * Multiple responses might be possible so the percentage might not add up to 100%.

Abbreviations: TV, television; SD, standard deviation; IQR, inter-quartile range; < less than; >more than

¥ As per B.G. Prasad scale 2016 classification at United States $1 = ₹74.3 on June 23, 2021.

Figure 1. Prevalence of Sleep Problems in Children Aged 2 to 5 Years in Chandigarh, India

Note: * Multiple options might have been chosen; # The sleep problems were dichotomized into “present” or “absent” based upon the cutoff scores in each subcategory, ie, “total sleep problems” at 41.12 (standard deviation (SD) = 5.49), “total sleep behaviors” at 12.36 (SD = 2.2), “Nighttime waking” at 2.76 (SD ± 1), “total morning wake-up problems” at 7.12 (SD = 1.7), and “total bedtime resistance” at 18.8 (SD = 3).
Association of Individual Sleep Problems with DSE
The bivariate analysis showed that total bedtime sleep resistance (15.1% vs 11%) and total sleep behavior problems (11.8% vs 5.6%) were significantly (P < .05) higher among children with higher DSE (more than 1 h per day) as compared to children watching electronic devices up to 1 h per day (Table 2).

Correlation of Individual Sleep Problems with DSE
The total sleep problems score (r = .142), total bedtime resistance’s score (r = .146), and the total sleep behaviors’ score (r = .1) had significant (P < .05) positive correlations with the DSE of the child (supplementary Table S2).

Correlation of Children’s Sleep Duration and Problems with Level of Physical Activity
The total sleep problems’ score had insignificant positive correlations with the average physical activity of the child (supplementary Table S3).

Predictors

Total Sleep Problems
The significant predictors of having total sleep behavioral problems among the children as per multivariate binary logistic regression analysis were living in a nuclear family (adjusted odds ratio (adjOR) = 2.4, CI [1.1, 5.3], P = .03), watching non-educational digital media content (adjOR = 2.6, CI [1.1, 6.2], P = .03), and absence of digital media rules at home (adjOR = 3.9, CI [1.3, 12], P = .01; Table 3).

Individual Sleep Problems
The child’s average DSE exceeding the guidelines (adjOR = 2.4, CI [1.1, 4.9], P = .02) was a significant predictor of total bedtime resistance problems. Also, living in a nuclear family (adjOR = 1.7, CI [1.1, 2.7], P = .03) was a significant predictor of difficulties with morning waking up problems (Table 3).

Discussion
This study has provided evidence that a higher DSE (more than 1 h per day) might be associated with children’s (2 to 5 years) sleep problems in Chandigarh, North India. The total sleep problems, bedtime resistance, and sleep behaviors were significantly positively correlated with the child’s DSE. The significant predictors of having sleep problems were children living in a nuclear family, watching non-educational digital media content, and living in homes where digital media rules were absent.

Children were primarily co-sleeping with their parents in the parents’ bedroom in this study, which is similar to Japanese and other Indian studies.16,20 The prevalence of co-sleeping in this study was considerably higher than that reported among American children (5%–52%) but similar to another Indian study (93%).21,22 A higher (51.5%) proportion of American parents used electronic devices to help their children (0 to 5 years) sleep as compared to only one-third of caregivers in the present study.23 Caregivers also reported keeping their children occupied with electronic devices to watch their favorite shows or work in America,23 in contrast to the American Academy of Pediatrics guidelines strictly prohibiting DSE before sleep for children.12

Table 2. Associations of Digital Screen Exposure with Sleep Problems Among Children Aged 2 to 5 Years

| Variables Related to Sleep | <1 h per day N = 162 (40.5%) | >1 h per day N = 238 (59.5%) | Total N = 400 (100%) | P Value |
|---------------------------|-------------------------------|-----------------------------|---------------------|--------|
| Total sleep duration      | 41.12 (5.49)                 |                             |                     | .08    |
| <7 h per day              | 10 (6.2)                     | 12 (5)                      | 22 (5.5)            |        |
| 7 h to 10 h per day       | 82 (50.6)                    | 123 (51.7)                  | 205 (51.2)          |        |
| >10 h per day             | 70 (43.2)                    | 103 (43.3)                  | 173 (43.3)          |        |
| Total sleep problems      | 18.8 (3)                     |                             |                     | .01    |
| Absent                    | 151 (93.2)                   | 202 (84.9)                  | 353 (88.3)          |        |
| Present                   | 8 (4.9)                      | 23 (9.7)                    | 31 (7.8)            |        |
| Bedtime sleep resistance  | 12.36 (2.2)                  |                             |                     | .03    |
| Absent                    | 153 (94.4)                   | 210 (88.2)                  | 363 (90.8)          |        |
| Present                   | 9 (5.6)                      | 28 (11.8)                   | 37 (9.3)            |        |
| Morning waking-up problems| 7.12 (1.7)                   |                             |                     | .52    |
| Absent                    | 127 (78.4)                   | 180 (75.6)                  | 307 (76.8)          |        |
| Present                   | 35 (21.6)                    | 58 (24.4)                   | 93 (23.3)           |        |
| Night time waking-up      | 2.76 (1)                     |                             |                     | .41    |
| Absent                    | 127 (78.4)                   | 178 (74.8)                  | 305 (76.3)          |        |
| Present                   | 35 (21.6)                    | 60 (25.2)                   | 95 (23.8)           |        |

Note: * < less than; > more than.
Existing evidence suggests that TV in the bedroom could reduce sleep time because of the displacement of the child’s circadian rhythm by watching bright electronic devices before bedtime. A Chilean study reported that nearly half of the families (51%) have a TV in the bedroom, which was distinctly lesser than in the present study (75%). A Japanese study suggested that having a device like a TV or a videogame in the bedroom increased the child’s (6-12 years) activity distinctly lesser than in the present study (75%). A Japanese study suggested that having a device like a TV or a videogame in the bedroom increased the child’s (6-12 years) activity distinctly lesser than in the present study (75%).

A Swedish study in 2001 observed that 4.9% of children (6-12 years) health concluded that DSE had a modest effect on their sleep. However, other social and contextual factors may have a more prominent influence, similar to the present study’s findings. A meta-analysis highlighted the impact of digital media content on the child’s fears and anxiety. Similarly, studies from America and India have reported bedtime resistance, behavioral problems, reduced bedtime sleep behaviors, excessive daytime sleepiness, awakening during the night, regularity and duration of sleep, and sleep-disordered breathing in children (under 15 years). The Indian and American Academy of Pediatrics advises only adult-supervised, age-appropriate, and high-quality media content specifically for children 2 to 5 years old.

A longitudinal Californian study among fourth to sixth graders predicted that nightly sleep duration was significantly associated with sedentary behaviors among American fourth to sixth graders. But, the relationship of sleep duration with DSE was negative and significant in our study. A multicenter birth cohort study demonstrated that every 1 h per day increase in the DSE decreased the sleep duration at follow-up visits and was associated with 3 to 8 lesser minutes of nighttime sleep and significantly reduced sleeping consistently. Children who complied with the American Academy of Pediatrics guidelines slept for an additional 20 min to 26 min. Also, another Indian study observed a reduction in sleep duration with an increase in the DSE’s duration, which was not observed in this study. This difference could be because of the total duration of sleep (daytime and nighttime) calculated as a cumulative score in the present study, the difference in study design (cohort), and the inclusion of older children (up to 15 years).
presence/absence of parental DSE rules at home.27 Likewise, in the present study, sleep problems among children were related to the lack of DSE rules at home. Our data concluded that children whose caregivers established digital media rules at home generally slept more and engaged in less sedentary behaviors than children whose caregivers did not impose such restrictions. Nevertheless, there were very few families with any digital media rules at home, so the results might not significantly affect sleep problems in our study. The prevalence of a high level of DSE (59.5%) in our study can be compared to a Malaysian study (63.05%), including children aged 0.5 to 12 years.31 However, the prevalence of DSE is notably lower than in Canadian children (82%) aged 3 to 5 years old.32

Warren et al, in 2016, concluded that sex and age-related differences existed in sleep behaviors among American children (fourth through sixth grade).27 Younger American children studying in grades 1 to 2 were more likely to have sleep problems than the older children studying in grades 3 to 4.1 However, in this study, sleep problems were not related to age, sex, and socioeconomic status, also supported by another Indian study.28 Similar to our findings, an Indian study indicated that sleep-related problems were significantly higher if the child lived in a nuclear family (adjOR 2.41; CI [1.04, 5.57]).29 As per our understanding, parents usually have a smaller accommodation with easy access to electronic devices in a nuclear family. In addition, when the parent has to work, they allow the child to watch electronic devices without supervision. This unsupervised and nonspecific content watched by the child leads to a higher DSE. While in a joint or an extended family, other family members might aid in caretaking, have other screen-free rooms, and siblings to play with that might act as distractions. The American Academy of Pediatrics explicitly mentions content-specific supervised DSE in 2 to 5 years old.12

This study’s major strength is that this is one of the first extensive community-based studies on this topic and age group in North India. Moreover, this study measures the DSE from all devices used by the child, unlike previous studies, allowing a consolidated measurement of DSE. It also highlighted sleep problems (bedtime resistance, nighttime waking, sleep behaviors, morning wake-up, and sleep duration) among young children. We performed advanced statistical analysis to interpret individual factors affecting various categories of sleep problems in children. This study’s results might reinforce the role of primary caregivers or parents in limiting the DSE at home as per the recommended guidelines.5,12 The cross-sectional analyses and dichotomized variables might not examine all the potential explanatory factors. The CHSQ-A version for children above 4 years of age was used. Hence, results need to be interpreted carefully regarding sleep habits for children 2 to 5 years old. However, the questionnaire was pretested and modified before data collection. Also, there might be recall bias as the questionnaire was proxy-reported by caretakers or parents. Lastly, the present study could not explore the underlying causes for parents not seeking consultation despite confronting sleep problems in their children.

Conclusion
We conclude that sleep problems were significantly associated with higher DSE (more than 1 h per day) among children aged 2 to 5 years old in Chandigarh, a North Indian Union Territory.

Declaration of Conflicting Interests
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Statement of Informed Consent and Ethical Approval
Necessary ethical clearances and informed consent was received and obtained respectively before initiating the study from all participants.

Supplemental Material
Supplemental material for this article is available online.

Lay Summary

What Is Already Known:
• TV viewing can cause sleep problems, bedtime resistance, delayed sleep onset, sleep anxiety, nighttime waking, and reduced sleep duration in preschool children.
• TV viewing reduces parents’ engagement with the child, making the children more vulnerable to digital media content leading to sleep problems.

What This Study Adds:
• This is the first community-based study that provides evidence on the associations of sleep problems with excessive digital screen exposure among children aged 2 to 5 years in an Indian city.
• The average digital screen exposure among children was measured with a validated digital screen exposure questionnaire in the Indian settings from all types of devices used.
• The significant predictors of sleep problems among children aged 2 to 5 years were living in a nuclear family, watching non-educational digital media content, and absence of digital media rules at home.
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