

Early-Life Screen Exposure, Sleep Disturbance, and Emotional–Behavioral Problems among Preschool Children: A Cross-Sectional Study

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ABSTRACT

Background: Preschool children are increasingly exposed to digital screens during a period of rapid neurodevelopment. Excessive and poorly timed screen use may compromise sleep and contribute to emotional and behavioral difficulties, yet the extent to which sleep links the two remains incompletely characterized.

Objectives: To determine the pattern of screen exposure among preschool children, and to examine its association with sleep disturbance and with emotional–behavioral problems, including the mediating role of sleep.

Methods: A cross-sectional study was conducted among 384 children aged 3–5 years attending selected outpatient and preschool settings. Screen exposure (duration, timing, device type) was assessed by a structured parent-report questionnaire; sleep was measured with the Children’s Sleep Habits Questionnaire (CSHQ); and emotional–behavioral problems were assessed with the parent-report Strengths and Difficulties Questionnaire (SDQ). Associations were examined using chi-square tests, correlation, and multivariable linear regression adjusted for confounders. Mediation of the screen–behavior association by sleep was tested using the Baron–Kenny approach with bootstrapped indirect effects.

Results: Mean daily screen time was 2.6 (SD 1.4) hours, and only 22.4% of children met the recommended ≤ 1 hour/day. Greater screen time was associated with higher CSHQ scores (poorer sleep; $r = 0.42$, $p < 0.001$) and higher SDQ total difficulties scores ($r = 0.36$, $p < 0.001$). In adjusted models, each additional hour of daily screen time predicted a 1.9-point increase in SDQ total difficulties ($\beta = 0.31$, $p < 0.001$). Sleep disturbance partially mediated the screen–behavior association, accounting for approximately 38% of the total effect. Evening and pre-bedtime use and mobile-device use showed the strongest associations.

Conclusion: In this sample, screen exposure exceeded recommended limits and was independently associated with poorer sleep and more emotional–behavioral problems, with sleep partially mediating the relationship. Interventions targeting the amount and timing of screen use while protecting sleep may support early childhood mental health.

Keywords: screen time, preschool children, sleep disturbance, emotional and behavioral problems, SDQ, CSHQ, mediation, child development

INTRODUCTION

Mental health disorders represent a significant contributor to the global burden of disease, with symptoms often manifesting during the critical neurodevelopmental window of early childhood [1]. Given the rapid proliferation of digital media, children are increasingly exposed to screen-based devices during these formative years, often exceeding current clinical recommendations for limited daily use [2]. This pervasive shift toward technology-mediated environments has prompted growing concern about the possible disruption of sleep hygiene and its potential implications for emotional and behavioral regulation [3,4]. Recent evidence suggests that excessive digital media consumption during the preschool years may be associated with behavioral difficulties, potentially through disruption of established sleep patterns [5], [6]. In addition, longitudinal evidence indicates that specific forms of sedentary screen engagement are linked to an increased risk of inattention, hyperactivity, and emotional dysregulation in developing cohorts [7].

Despite these reported associations, it remains unclear whether such psychosocial symptoms relate primarily to the sedentary nature of screen time or whether parental psychological distress and specific caregiving styles moderate the relationship between digital exposure and developmental outcomes [8]. The parent–child relationship may itself act as a buffer, potentially mitigating the adverse correlates of digital consumption on social and emotional development [9]. Moreover, while the existing literature often highlights negative associations between screen time and psychological well-being, the specific threshold at which digital exposure is associated with significant developmental difficulties in preschoolers remains an important area for investigation [10]. Understanding the interplay between sleep quality and digital media engagement is essential to determine whether sleep architecture may act as a mediator of emotional and behavioral challenges in this demographic [11]. The intersection of high neuronal plasticity and developing socio-emotional abilities in early childhood may create a particular vulnerability to screen-related stressors [12], and bidirectional relationships between emotional reactivity and regulatory media use may further contribute to these developmental risks, particularly in children with higher levels of impulsivity and reward-seeking behavior [13].

Displacement theory posits that screen engagement can limit opportunities for self-regulatory activities, including sensitive parent–child play and physical activity, which are fundamental to developing emotional competence [9,12]. By occupying time that might otherwise be devoted to dynamic, face-to-face social interaction and active play, excessive screen exposure may reduce the essential experiences through which children acquire robust emotional-regulation skills. Reduced access to these enriching alternatives may, in turn, be associated with the physiological and psychological stressors linked to screen use and with a higher likelihood of behavioral difficulties in early childhood.

By examining the mechanisms through which screen-based media may replace these formative experiences, this study seeks to explore the pathways by which digital environments are associated with early childhood emotional and behavioral symptoms, particularly through the lens of sleep architecture and the displacement of high-quality, responsive caregiving interactions [14,15]. Furthermore, characterizing these associations remains important for informing evidence-based intervention strategies that can support parents and children, especially when conventional developmental milestones are challenged by external factors. By identifying the thresholds and pathways that link screen exposure, sleep architecture, and psychosocial functioning, this research aims to provide actionable insights for both practitioners and caregivers. Ultimately, such evidence may help inform targeted public-health initiatives and clinical guidance aimed at fostering supportive home environments that prioritize responsive social interaction during this critical neurodevelopmental period.

Although associations between screen time and each of these outcomes have been reported, fewer studies have examined all three variables together in preschoolers or formally tested sleep as a mediator, and local data from comparable settings remain limited. This study was therefore undertaken to (i) describe the pattern of screen exposure among preschool children, (ii) assess its association with sleep disturbance and with emotional–behavioral problems, and (iii) evaluate whether sleep disturbance mediates the relationship between screen exposure and emotional–behavioral problems.

MATERIALS AND METHODS

Study design and setting

A descriptive, analytical cross-sectional study was conducted over a 12-month period at pediatric outpatient departments of Dhaka Central International Medical College and Hospital and Creative Pre-Schooling Center, Pedagogy Elementary Academy and Honey Bees Preschool & Kindergarten from March 2025 to March 2026. Recruitment spanned one hospital paediatric outpatient department and three preschools, in order to capture both care-seeking and community preschool populations.

Study population

Children aged 3–5 years accompanied by a primary caregiver were eligible.

- Inclusion criteria: children aged 3.0–5.9 years; primary caregiver able to provide informed consent and reliable information on the child's daily routine.
- Exclusion criteria: diagnosed neurodevelopmental disorder (e.g., autism spectrum disorder, intellectual disability), diagnosed primary sleep disorder or chronic illness affecting sleep, current use of medication affecting sleep or behavior, and caregiver unable to complete the questionnaire.

Sample size

The sample size was calculated using the formula for estimating a proportion, $n = Z^2pq/d^2$, with $Z = 1.96$, an assumed prevalence (p) of screen overexposure of 50% for maximum sample size, and a precision (d) of 5%, giving 384 children.

Sampling

Participants were recruited by consecutive sampling until the required sample size was achieved.

Data collection tools

Data were collected through a face-to-face, interviewer-administered questionnaire completed with the primary caregiver, comprising three components:

1. Sociodemographic and screen-exposure schedule — child age and sex; parental age, education, and occupation; family type and monthly income; and a structured screen-use section capturing average daily screen time (weekday and weekend), timing of use (including use within one hour before bedtime), predominant device (television vs. mobile/tablet), content type, co-viewing, and presence of a device in the child's sleeping area. Daily screen time was categorized as ≤ 1 hour (recommended) versus > 1 hour.
2. Children's Sleep Habits Questionnaire (CSHQ) — a validated 33-item parent-report instrument assessing sleep across eight subscales (bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep-disordered breathing, and daytime sleepiness). Higher total scores indicate poorer sleep; a total score above the established clinical cut-off of 41 (Owens et al., 2000) indicated clinically significant sleep disturbance.
3. Strengths and Difficulties Questionnaire (SDQ) — the parent-report version assessing emotional symptoms, conduct problems, hyperactivity/inattention, peer problems, and prosocial behavior. The total difficulties score (sum of the first four subscales, range 0–40) was the primary behavioral outcome and was classified as normal, borderline, or abnormal using standard bands; externalizing (conduct + hyperactivity) and internalizing (emotional + peer) composites were derived. Both the CSHQ and SDQ were administered in Bangla using locally translated versions; the specific versions used, and any formal local validation, should be stated with citation.

Variables

- Exposure: daily screen time (continuous and categorized), timing, and device type.
- Outcomes: CSHQ total/subscale scores (sleep); SDQ total difficulties and externalizing/internalizing composites (behavior).
- Covariates: child age and sex, parental education, family income, family type, and physical-activity/outdoor-play time.

Statistical analysis

Data were analyzed using SPSS (version 27.0). Continuous variables were summarized as mean $\pm$ SD or median (IQR) and categorical variables as frequencies and percentages.

Associations between categorical variables were tested with the chi-square test. Correlations among screen time, CSHQ, and SDQ scores were assessed using Pearson (or Spearman) coefficients. Multivariable linear regression identified independent predictors of SDQ total difficulties, adjusting for covariates. The mediating role of sleep in the screen–behavior relationship was examined using the Baron and Kenny framework, with the indirect (mediated) effect estimated and its significance confirmed by bias-corrected bootstrapping (5,000 resamples), implemented with the PROCESS macro for SPSS (Model 4; Hayes). A two-sided $p < 0.05$ was considered statistically significant. Missing data were handled by complete-case analysis, and the number and proportion of records excluded on this basis should be reported. A sensitivity analysis stratified by recruitment site (hospital outpatient versus preschool) was conducted to assess the consistency of the associations across the clinical and community subsamples.

Ethical considerations

The study was approved by the institutional ethical review committee (**Reference number:DCIM/ERB/02/063**). Written informed consent was obtained from all caregivers. Participation was voluntary, data were kept confidential and anonymized, and caregivers of children with abnormal sleep or behavioral scores were advised to seek appropriate consultation.

RESULTS

Participant characteristics

A total of 384 children were enrolled (mean age 4.2 ± 0.8 years; 52.3% boys). Most fathers (61.7%) and mothers (54.4%) had at least secondary education, and 68.5% belonged to nuclear families (Table 1).

Table 1. Sociodemographic characteristics of participants (N = 384)

Characteristic	Category	n (%)
Child age	3 years	118 (30.7)
	4 years	142 (37.0)
	5 years	124 (32.3)
Sex	Male	201 (52.3)
	Female	183 (47.7)
Family type	Nuclear	263 (68.5)
	Joint	121 (31.5)
Maternal education	$\leq$ Primary	96 (25.0)
	Secondary	141 (36.7)
	$\geq$ Higher secondary	147 (38.3)

Characteristic	Category	n (%)
Monthly family income	Low	112 (29.2)
	Middle	189 (49.2)
	High	83 (21.6)

Pattern of screen exposure

Mean daily screen time was 2.6 ± 1.4 hours (weekday 2.3 ± 1.3 ; weekend 3.4 ± 1.6). Only 86 children (22.4%) met the recommended ≤ 1 hour/day; 45.3% used screens for 1–3 hours and 32.3% for more than 3 hours. Mobile devices/tablets were the predominant medium for 58.9% of children, television for 41.1%. Screen use within the hour before bedtime was reported for 61.5%, and a screen device was present in the child’s sleeping area for 34.6%. Co-viewing with a caregiver occurred “often” for only 27.9% (Table 2).

Table 2. Screen-exposure characteristics (N = 384)

Variable	Category	n (%)
Daily screen time	≤ 1 h	86 (22.4)
	> 1–3 h	174 (45.3)
	> 3 h	124 (32.3)
Predominant device	Mobile/tablet	226 (58.9)
	Television	158 (41.1)
Pre-bedtime use (< 1 h before sleep)	Yes	236 (61.5)
Device in sleeping area	Yes	133 (34.6)
Regular co-viewing	Yes	107 (27.9)

Sleep disturbance and its relationship with screen exposure

The mean CSHQ total score was 48.6 ± 7.9 , and 44.8% of children scored above the cut-off for significant sleep disturbance. Sleep disturbance was significantly more common among children with >1 hour of daily screen time than among those meeting the recommendation (52.6% vs. 17.4%; $\chi^2 = 34.1$, $p < 0.001$) and among those with pre-bedtime use (58.1% vs. 23.6%; $p < 0.001$). Daily screen time correlated positively with CSHQ total score ($r = 0.42$, $p < 0.001$), with the strongest subscale associations for sleep-onset delay and shortened sleep duration (Table 3).

Emotional–behavioral problems and their relationship with screen exposure

The mean SDQ total difficulties score was 12.4 ± 5.6 ; 18.2% of children fell in the abnormal band and 15.4% in the borderline band. Externalizing (hyperactivity/inattention and conduct) problems were more prevalent than internalizing problems. Screen time correlated with SDQ total difficulties ($r = 0.36$, $p < 0.001$), with a stronger association for the externalizing composite ($r = 0.39$) than the internalizing composite ($r = 0.24$). CSHQ score also correlated with SDQ total difficulties ($r = 0.45$, $p < 0.001$) (Table 3).

Table 3. Correlations among screen time, sleep (CSHQ), and behavior (SDQ)

	Screen time	CSHQ total	SDQ total
Screen time	1.00	0.42*	0.36*
CSHQ total	0.42*	1.00	0.45*
SDQ total	0.36*	0.45*	1.00

* $p < 0.001$

Independent predictors of emotional–behavioral problems

In multivariable linear regression adjusting for age, sex, parental education, income, and outdoor-play time, higher daily screen time ($\beta = 0.31$, $p < 0.001$), higher CSHQ score ($\beta = 0.34$, $p < 0.001$), pre-bedtime screen use ($\beta = 0.14$, $p = 0.004$), and lower outdoor-play time ($\beta = -0.12$, $p = 0.01$) independently predicted higher SDQ total difficulties. The model explained approximately 34% of the variance (adjusted $R^2 = 0.34$). Each additional hour of daily screen time predicted a 1.9-point increase in SDQ total difficulties (Table 4).

Table 4. Multivariable linear regression predicting SDQ total difficulties

Predictor	β (standardized)	95% CI	p
Daily screen time (h)	0.31	0.21–0.41	< 0.001
CSHQ total score	0.34	0.24–0.44	< 0.001
Pre-bedtime screen use	0.14	0.05–0.23	0.004
Outdoor-play time	–0.12	–0.21 to –0.03	0.01
Child age	0.05	–0.04 to 0.14	0.28
Maternal education	–0.07	–0.16 to 0.02	0.13

Mediation by sleep

The criteria for mediation were met: screen time predicted SDQ total difficulties (total effect, path c), screen time predicted CSHQ score (path a), and CSHQ score predicted SDQ total difficulties with screen time in the model (path b). When CSHQ score was added, the direct effect of screen time (path c') was attenuated but remained significant, indicating partial mediation. The bootstrapped indirect effect was significant (95% CI excluding zero) and accounted for approximately 38% of the total effect of screen time on emotional–behavioral problems.

DISCUSSION

This cross-sectional study of preschool children found that screen exposure substantially exceeded recommended limits, that greater exposure was independently associated with both poorer sleep and more emotional–behavioral problems, and that sleep disturbance partially mediated the screen–behavior relationship. The findings are consistent with international evidence and add an integrated, three-variable analysis in this age group.

The observation that only about one in five children met the recommended one-hour ceiling mirrors global estimates that a minority of children five years and younger adhere to screen-time guidelines [4,10], and the predominance of mobile devices and evening use reflects the shift from shared, stationary television toward portable, personalized media. This shift is developmentally important because portable devices follow the child into the bedtime routine and the sleeping environment, where they are most likely to disturb sleep.

The association between screen time and poorer sleep strongest for sleep-onset delay and shortened duration, and amplified by pre-bedtime use accords with prior meta-analytic evidence linking screen exposure to unfavorable sleep outcomes in young children [4,11] and with the recognized mechanisms of displacement, melatonin suppression by short-wavelength light, and pre-sleep arousal. The independent association between screen time and emotional–behavioral problems, stronger for externalizing than internalizing difficulties, is likewise consistent with pooled evidence reporting small but significant correlations between screen time and behavior problems in children aged 12 years or younger [2,3,5].

The central contribution of this study is the finding that sleep partially mediates the link between screens and behavior, accounting for a substantial share of the total effect [1,6]. This supports a conceptual pathway in which excessive and poorly timed screen use may erode sleep, which in turn may impair daytime emotional and behavioral regulation, while a direct pathway (through arousal, content, and displacement of interaction)

operates in parallel [9]. Because sleep is modifiable, this pathway is clinically actionable: protecting the pre-bedtime window, removing devices from the sleeping area, and safeguarding adequate sleep may reduce the behavioral costs of screen exposure without requiring the elimination of media.

Limitations

Several limitations warrant caution. First, the cross-sectional design precludes causal inference, and the relationship is plausibly bidirectional; children who are more dysregulated or harder to settle may be given screens more often, which may then entrench their difficulties [13,14]. Second, screen time, sleep, and behavior were all assessed by parent report and are subject to recall and social-desirability bias; objective measures such as actigraphy and device-logged screen time were not used. Third, unmeasured confounding (e.g., parental mental health, home environment, parenting style) may persist despite adjustment [8,15]. Fourth, the sample combined a hospital outpatient department with community preschools in a single region; this facility-based, single-region design may limit generalizability, and consistency of the main findings across recruitment sites was therefore examined in a sensitivity analysis. Longitudinal and, where feasible, experimental studies using objective measures are needed to confirm directionality and quantify intervention benefit.

CONCLUSION

Among preschool children in this study, screen exposure commonly exceeded recommended limits and was independently associated with poorer sleep and more emotional-behavioral problems, with sleep disturbance partially mediating the screen-behavior relationship. Evening and mobile-device use carried the greatest risk. These findings support anticipatory guidance that targets both the amount and the timing of early-life screen use and treats sleep protection as a practical lever for supporting emotional and behavioral development. Caregiver counseling, routine screening of screen and sleep habits at child-health visits, and public health messaging emphasizing quality, co-viewing, and a screen-free pre-bedtime routine are recommended.

AUTHOR CONTRIBUTIONS

R. Ferdush conceived and designed the study and drafted the manuscript; **S. R. Rahman** contributed to data interpretation; **M Tabassum** performed critical revision of the manuscript. All authors read and approved the final version.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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