The Relationship Among Screen Use, Sleep, and Emotional/ Behavioral Difficulties in Preschool Children with Neurodevelopmental Disorders

Jiayong Lin,* Iliana Magiati,* Shi Hui Rachel Chiong,* Swati Singhal,† Natasha Riard,† Isabel Hui-Xuan Ng,‡ Falk Muller-Riemenschneider,§ Chui Mae Wong†

ABSTRACT: ***Objective:*** **Despite evidence that excessive screen use may contribute to negative health, developmental, emotional, and behavioral outcomes, more children are engaging in increasing amounts of screen-related activities. For children with neurodevelopmental conditions, increased screen use could exacerbate emotional/behavioral difficulties (EBDs) by interfering with sleep quantity and quality.** ***Aims:*** **This study examined the possible mediating role of sleep in the relationship between screen use and EBDs in preschool children with neurodevelopmental disorders (NDDs) clinically referred to a child development center in Singapore.** ***Methods:*** **A screen use questionnaire developed for the purposes of the present study, the Children's Sleep Habits Questionnaire, and the Strengths and Difficulties Questionnaire were completed by 367 caregivers of 2- to 5-year-old children with NDDs (39.5% autism spectrum disorder; 36.8% speech-language disorders; 23.7% others).** ***Results:*** **Average daily screen use duration was 3.98 hours, with 93.9% exceeding 1 hour of screen time daily. 57.7% of children had screen devices in their bedrooms, while 52% commenced screen use at the age of 18 months or earlier. Sleep problems fully mediated the relationship between the number of bedroom screen devices and children's EBDs, as well as between the age of first screen use and EBDs, but not between hours of screen use and EBDs. Controlling for age, developmental level, and family income, children who started using screens earlier than 18 months and who had screen devices in their bedrooms had significantly more sleep problems and EBDs than those without.** ***Conclusion:*** **Children with neurodevelopmental conditions may have more difficulties disengaging from screen devices in their bedrooms, and an earlier age of screen exposure may contribute to more chronic disruption of sleep.**

(*J Dev Behav Pediatr* 40:519–529, 2019) **Index terms:** screen use, sleep, emotional/ behavioral difficulties, preschool children, neurodevelopmental disorder or condition.

Screen use refers to the use of screen devices, including televisions, video games consoles, computers, tablets, and smartphones. Increasingly more children are engaging with screen devices for longer periods and starting at younger ages. In the United States, daily screen time (i.e., duration of screen use) of children aged 8 years and younger had increased from 1 hour 55 minutes in 2013 to 2 hours 19 minutes in 2017[1]; screen time also increased with age from 42 minutes in children younger than 2 years to 2 hours 39 minutes in 2- to 4-year-old children and subsequently to 2 hours 56 minutes in children aged 5 to 8 years.[1]

From the *Department of Psychology, National University of Singapore, Singapore; †Department of Child Development, KK Women's and Children's Hospital, Singapore; ‡Department of Paediatrics, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom; §Yong Loo Lin School of Medicine, National University of Singapore, Singapore.

Received December 2017; accepted March 2019.

Disclosure: The authors declare no conflict of interest.

This seeks to inform that the appended paper represents an original contribution. It has not been previously published and is currently not being considered for publication elsewhere.

Address for reprints: Jiayong Lin; e-mail: e0010378@u.nus.edu.

The American Academy of Pediatrics recommended in a policy statement[2] to avoid screen use in children younger than 18 months; for parents of 18 to 24 month old children to engage in screen use jointly with their children; and limited independent screen use up to 1 hour per day for children older than 2 years. Although there may be some educational and socioemotional benefits from selected screen use on child development,[3] increased screen use and the presence of bedroom screen devices have been associated with decreased sleep duration,[4] even in infants.[5] Furthermore, several, mostly, cross-sectional studies have reported consistent associations between early and sustained increased screen use, poorer language and cognitive development,[6] and more emotional/behavioral difficulties (EBDs) in typically developing children worldwide.[7,8] Increased screen use has also been associated with overall poorer family functioning and poorer maternal well-being, possibly related to lower quality parent-child interactions and displacement of other activities that may better promote emotional-behavioral well-being, which may over time foster reliance on screen use as a daily habit to occupy children during daily routines.[9,10] Conversely, caregivers of children with preexisting EBDs may rely on screen devices as a calming tool when children are upset, thereby over time displacing the development of the child's internal self-regulation mechanisms, in turn increasing screen use over time and perpetuating difficulties with emotional/behavioral regulation.[10]

Children with Neurodevelopmental Disorders and Screen Use

Neurodevelopmental disorders (NDDs) in the Diagnostic and Statistical Manual for Mental Disorders, Fifth Editior[11] include intellectual disability (ID), global developmental delay (GDD), speech and language disorders (SLs), autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), and specific learning disorders (LDs).

Lo[12] conducted a retrospective analysis of more than 56,000 US school-aged children and adolescents with and without NDDs using data extracted from the 2007 National Survey of Children's Health. Compared with typically developing children, children with NDDs (ASD, ADHD, GDD, and LD) in this study had higher daily average screen times, although ADHD was reported to be the main NDD impacting screen time behavior. Considering how children with NDDs are at overall higher risk for poorer developmental outcomes, it is possible that increased screen use may further exacerbate these.

Currently, research is scarce in this population, and findings are mixed, making it premature to draw any firm causal links. Most research to date has been published in relation to children with ASD and ADHD,[13,14] with very few, if any, to our knowledge, studies in children with other NDDs. Compared with typically developing children, children with ASD have more compulsive Internet and video game use and more difficulties disengaging from screen use, possibly due to the repetitive and restricted nature of the screen content; they also present with more inattention and are more negatively impacted by screen use in their social, educational, and family life.[15] At the same time, other studies have suggested that screen devices can be useful as enabling tools of communication and support in teaching activities of daily living, vocational/employment, language, and promoting communication and social skills in people with ID and ASD.[16]

Screen Use and Sleep in Children With Neurodevelopmental Disorders

In typically developing children, one possible mechanism through which screen use may exert negative effects is by affecting their sleep: by quantitatively displacing sleep or activities related to good sleep hygiene and/or by qualitatively disrupting sleep through physiological arousal, suppressing melatonin production,[17] or delaying circadian rhythm.[18] One review[19] explains that children's sleep disturbances can contribute to problems of executive function, hyperactivity, social function, conduct, mood, and anxiety. Many of these outcomes have also been associated with excessive screen use and may suggest overlapping pathways in how screen use and sleep may affect children.

Sleep problems are often much more common and impairing among children with NDDs than among their typically developing peers, whereas the presence of bedroom screen devices has been associated with shorter sleep duration among children with ASD and ADHD, possibly attributed to more trouble disengaging from screen devices; greater susceptibility to lit screens disrupting their melatonin levels; and/or greater susceptibility to screen arousal and insomnia due to their higher risk for autonomic hyperarousal.[13] Further analyses of screen use specifically by children with ASD appear to suggest that it may matter less whether bedroom screen devices are present or not but what was more important was whether screen use was carried out during preparation to bedtime routines; in particular, violent content prior to bedtime was significantly associated with delayed sleep onset in a study of 101 young people with ASD aged 6 to 14 years in the United States using caregiver report.[14]

Does Sleep Mediate the Relationship Between Screen Use and Emotional/Behavioral Difficulties in Children With Neurodevelopmental Disorder?

The consistent relationships found across different studies between screen use, sleep, and EBDs in both neurotypical children and children with NDDs point toward a possible mediating role of sleep. Supporting this, laboratory-controlled and cross-sectional studies of typically developing children and adolescents have found reduced sleep and poorer sleep quality to mediate the influence of screen time on attention problems, physical aggression, and emotional and somatic problems.[20,21]

Considering how children with NDDs are already at an elevated risk for EBDs in addition to sleep problems, when screen time disrupts sleep, these difficulties may be exacerbated. In an effort to manage some of the challenges of caring for a child with NDDs, caregivers may also resort to more screen use to soothe or engage their child, further interfering with the child's sleep and development in a negative developmental trajectory.[22]

The Present Study: Rationale, Aims, and Research Questions

There are currently several gaps and limitations in the existing literature. First, studies are often limited to specific NDD subgroups, particularly ASD and ADHD, while underrepresenting other groups; to date, very few studies have examined factors implicated in screen use and child outcomes in preschool children with neurodevelopmental concerns presenting to routine developmental pediatric clinic settings.[23] Second, research has largely been limited to examining screen time, when other aspects of screen use (i.e., settings, age of onset) also need to be considered. Finally, to our knowledge, no studies have yet examined the mediating relationship between screen use, emotional/behavioral problems, and sleep in young children with NDD.

Singapore is one of the most tech-savvy countries worldwide. Singaporean children aged 0 to 6 years are reported to spend an average of 2.5 hours daily on television and an additional 1.6 hours online,[24] while more than half of Singaporean children aged 2 years and younger (n = 388; 53.5%) engage in daily screen use for 60–80 minutes.[25]

The present study sought to address some of the above limitations in the existing literature by exploring screen use, sleep, and EBDs in a large sample of preschool children routinely presenting to a developmental pediatric clinic. Pragmatically too, this study did not want to exclude any particular NDD diagnostic group from the diverse range of clinical cases typically seen in such settings, particularly because non-ASD, SL, and ADHD groups are already underrepresented in the literature on screen use. The following hypotheses were examined:

1. Increased screen use (defined as average daily screen time, age of first screen exposure, or the number of bedroom screen devices) will be associated with poorer sleep quantity and quality and more caregiver-reported EBDs.
2. Sleep quantity and/or quality will mediate the relationship between screen use (screen time, age of first screen exposure, or the number of bedroom devices) and EBDs.

METHODS

Participants

Setting

Participants were recruited among caregivers attending appointments for their child at the Department of Child Development (DCD), KK Women's and Children's Hospital (KKH), Singapore, which sees the majority of children aged 1 to 6 years referred for neurodevelopmental concerns in Singapore yearly. Children are referred to the DCD by family physicians or primary care pediatricians from both public and private health care sectors. (children in Singapore start formal schooling at 7 years; should they be referred for assessment after they have started school, they would be seen in a different health care organization and clinic for young people of 7 to 18 years of age). At each child's first visit to the DCD, a detailed developmental history, physical examination, and developmental screening assessment using the Ages and Stages Questionnaires, Third Edition (ASQ-3[26]), is conducted by a multidisciplinary team of qualified doctors, nurses, and associate psychologists or allied professionals. Further formal psychological or speech and language/occupational therapy assessments would usually then be conducted for those children with suspected autism spectrum disorder, intellectual disability, or language disorders as recommended. Diagnoses are made using Diagnostic and Statistical Manual for Mental Disorders Fifth Edition (DSM-5) criteria, taking all the assessment information gathered into consideration.

Inclusion/Exclusion Criteria

Children younger than 6 years, who were Singaporean citizens or permanent residents, and had obtained a clinical diagnosis of a DSM-5 neurodevelopmental disorder (NDD) were included in this study. The children were all assessed and diagnosed by qualified DCD-KKH pediatricians, with 172 (46.9%) having completed additional standardized and/or clinical assessments by psychologists, speech and language therapists, or occupational therapists as part of standard clinical care at the time of data collection. Diagnostic NDD information and previous assessment results were extracted from children's case files. There were no exclusion criteria pertaining to children's intellectual or verbal functioning.

Participant Characteristics

The final sample included 367 children, most of whom were Singaporean ethnically Chinese, male, English speaking, and from middle and upper middle class married families (Table 1).

Procedure

Ethics

Ethics approval was granted by the SingHealth Centralised Institutional Review Board (Reference 2015/2459).

Recruitment

From July 2015 to July 2016, caregivers who attended appointments with their child at the DCD-KKH were recruited by the first and third authors who approached the caregivers to inform them about the study, answer any questions they had, and provide them with a participant information sheet and consent form. Of 500 participants approached, 25 refused or withdrew participation, and 108 did not meet study inclusion criteria (11 were aged 6+ years, 1 was nonresident, and 96 had no NDD diagnosis); therefore, the final sample size was 367.

Data Collection

Once information about the study was shared and signed consent obtained, caregivers were given the questionnaires to complete during their appointment waiting time or at home, to then be returned to the research team by post in addressed and stamped envelopes provided.

Measures

Demographics

Parents provided information on core child and family characteristics and demographics, including ethnicity, family income, and diagnosis.

Developmental Performance Screen

Routinely administered at the child's first visit to the DCD-KKH, the ASQ-3 is a tool designed to screen the

Table 1. Child and Family Characteristics by NDD Diagnostic Group

Sample Characteristics	Valid Cases, N (%)	Total	ASD, n = 145	SL, n = 135	Others, n = 87	Group Differences[a]
Child characteristics						
Age, yr, mean (SD)	367 (100%)	4.05 (1.24)	3.86 (1.16)	3.84 (1.29)	4.66 (1.08)	$F(2,104) = 4.32$; $\mathbf{p = 0.02}$*; $\eta^2 = 0.077$. Others > ASD; others > SL
Gender, n (%)	367 (100%)					$F(2,104) = 0.05$; $p = 0.96$; $\eta^2 = 0.001$
Male		273 (74.4%)	116 (80%)	95 (70.4%)	62 (71.3%)	
Female		94 (25.6%)	29 (20%)	40 (29.6%)	25 (28.7%)	
Ethnicity,[b] n (%)	367 (100%)					$F(2,104) = 2.32$; $p = 0.10$; $\eta^2 = 0.043$
Chinese		262 (71.4%)	105 (72.4%)	102 (75.6%)	55 (63.2%)	
Malay		74 (20.2%)	24 (16.6%)	23 (17%)	27 (31.0%)	
Indian		20 (5.4%)	9 (6.2%)	7 (5.2%)	4 (4.6%)	
Eurasian		1 (0.3%)	0 (0%)	1 (0.7%)	0 (0%)	
Others		10 (2.7%)	7 (4.8%)	2 (1.5%)	1 (1.1%)	
ASQ-3-*z*, mean (SD)	294 (80.1%)	−1.75 (1.12)	−2.29 (1.02)	−1.20 (0.85)	−1.68 (1.24)	$F(2,104) = 13.61$; $\mathbf{p < 0.001}$***; $\eta^2 = 0.207$. ASD < SL; ASD < others
Family characteristics						
Marital status, n (%)	367 (100%)					
Married		346 (94.3%)	139 (95.9%)	125 (92.6%)	82 (94.3%)	$F(2,104) = 1.24$; $p = 0.30$; $\eta^2 = 0.023$
Single		4 (1.1%)	1 (0.7%)	2 (1.5%)	1 (1.1%)	
Divorced		15 (4.1%)	5 (3.4%)	6 (4.4%)	4 (4.6%)	
Widowed		2 (0.5%)	0 (0%)	2 (1.5%)	0 (0%)	
Family monthly income,[c] n (%)	366 (99.7%)					$F(2,104) = 0.09$; $p = 0.92$; $\eta^2 = 0.002$
<\$1200		6 (1.6%)	3 (2.1%)	2 (1.5%)	1 (1.1%)	
\$1200–\$3000		59 (16.1%)	23 (15.9%)	21 (15.6%)	15 (17.2%)	
\$3001–\$5000		87 (23.8%)	35 (24.1%)	32 (23.7%)	20 (23.0%)	
\$5001–\$10,000		130 (35.5%)	46 (31.7%)	52 (38.5%)	32 (36.8%)	
>\$10,000		80 (21.9%)	37 (25.5%)	25 (18.5%)	18 (20.7%)	

Questionnaire 3 standardized scores; −1 = nonclinical; −1 to −2 = borderline impairment; −2 = clinical impairment; *$p < 0.05$; **$p < .01$; ***$p < 0.001$; values in **bold** are statistically significant. [a]Group differences were examined using multivariate analyses of variance. [b]The ethnic distribution in the sample is generally representative of the overall Singapore ethnic distribution: Chinese, 74.3%, Malay, 13.3%, Indian, 9.1%, and others, 3.2% (Department of Statistics Singapore, 2016). [c]Median monthly family income in Singapore in 2016 is S\$8,846 (Singapore Statistics, 2016). ASD, autism spectrum disorder; ASQ-3-z, Ages and Stages Questionnaires, Third Edition, z-score; Others, other neurodevelopmental disorders; SL, speech and language disorders.

developmental performance of young children aged 1 to 60 months. It is a 30-item parent-reported age-grouped questionnaire with good test-retest reliability (r =0.75–0.82), internal consistency ranging from $\alpha = 0.51$ to 0.87, and very good sensitivity (86.1%) and specificity (85.6%) in identifying children with developmental delay. Raw scores for each domain were standardized into z scores and averaged to give an ASQ-3 average z score (ASQ-3-z); 38.4% (n = 113) of the sample had clinical levels of developmental delay, 35.1% (n = 103) had borderline developmental delay, and the remaining 26.5% (n = 81) were developmentally normal.

Screen Use and Correlates

These were measured by a questionnaire developed for the purposes of this study comprising 31 items, including questions on the number of bedroom screen devices, age of first screen exposure (in months), and weekday and weekend screen times of the child and the parent across multiple devices (television, computers, game consoles, mobile devices), which were used to calculate an average daily screen time (in hours) as consistent with the previous literature (after summing screen times across all devices, averaging was done by multiplying weekday screen time by 5, multiplying weekend screen time by 2, summing them together, and dividing by 7).[13,25] The questionnaire was adapted from a previous version used by Goh et al.[25] in a Singapore study on sociodemographic, home environment, and parental influences on screen viewing in children younger than 2 years.

Sleep Quantity and Quality

The Children's Sleep Habits Questionnaire (CSHQ[27]) was used. Average daily sleep duration was calculated from the CSHQ fields of the child's sleep, wake, and nap times, for weekdays and weekends. The CSHQ also includes a 33-item measure of sleep problems (i.e., quality) that make up a total CSHQ total score (range, 31–97; there are 2 items scored on 0, 1, 2, whereas the remaining 31 items are scored on 1, 2, 3). The CSHQ showed adequate internal consistency in both a community sample ($\alpha = 0.68$) and clinical sample ($\alpha = 0.78$), good test-retest reliability (r = 0.62–0.79), specificity (0.72), and sensitivity (0.80) in identifying sleep disorders in school-aged children.[27] Normative comparisons can also be made with an earlier study on 372 typically developing Singaporean preschool children.[28]

Emotional/Behavioral Difficulties

Caregivers completed the age-appropriate version of the Strengths and Difficulties Questionnaire (SDQ[29]) (for 2–4 years or for 4–17 years). Both comprise 25 items and make up a total difficulties index raw score (range, 0–40; higher scores = more difficulties). It has adequate internal consistency (α = 0.73) and discriminates well between psychiatric and nonpsychiatric samples (specificity, 0.95; sensitivity, 0.63[29]).

Statistical Analyses

Missing Data and Erroneous Responses

Missing data were replaced with the mean of the subscale only if there was no more than 1 missing item (in 28 cases [7.6%] for SDQ subscales; 55 cases [15.0%] for CSHQ subscales). Multiple responses to a single question were removed and treated as missing data.-Extreme and/or erroneous entries were treated as missing data: screen time duration entries exceeding 14.8 hours per day [Accounts for the sample's awake duration; 24 hours – 11.34 (sample's mean sleep duration) + 2*1.07 (SD) = 14.8; 3 cases; 0.8%]; as well as sleep duration entries exceeding 14.1 hours or below 7.5 hours per day [Derived from a previous study on Singaporean preschool children's sleep (Aishworiya et al., 2012); 10.8 hours (mean sleep duration) + 3*1.1 (SD) = 7.5 to 14.1 hours; 32 cases; 8.7%] Missing data (including errors) were most apparent in summary measures of the number of bedroom screen devices (n = 147; 40.1%), average daily screen time (n = 89; 24.3%), and average daily sleep duration (n = 72; 19.6%) because these could not be calculated if their component items had missing values (analyses using subscale scores with fewer missing data were also carried out, but results and patterns of significant/nonsignificant findings and strengths were similar; hence, using summary scores was adopted and presented in this article).

Data Analytic Plans

The study sought to examine screen use, sleep, and emotional/behavioral difficulties (EBDs) in children with NDDs referred to the developmental pediatric clinic. To investigate the sample as a whole, differences between the NDD subgroups were first explored with multivariate analyses of variance, and those variables were controlled for in subsequent analyses (see preliminary analyses in Results). Correlational analyses examined the relationship between screen use, sleep, and EBD variables; both composite and subscale variables were explored. Using Process macro (model 4) in SPSS, we then aimed to address the mediation hypotheses that increased screen use (predictor) contributed to more EBDs (outcome) through more sleep problems (mediator). A bootstrap analysis of 5000 samples (i.e., to derive unbiased estimate of confidence interval through approximating distribution) was used to derive the indirect effect of the mediator. Because of the large number of analyses and the relatively large sample size, effect sizes are reported and guided the interpretation of the findings.

RESULTS

Preliminary Analyses

Descriptive Statistics

Most participants (93.9%) exceeded the 1 hour of average daily screen time recommended by the American Academy of Pediatrics (AAP) (Table 2). Just under 60% had 1 or more bedroom screen devices, whereas more than half were exposed to screens at the age of 18 months or earlier (Table 2).

On the Children's Sleep Habits Questionnaire (CSHQ), caregivers reported average daily sleep duration of 11.34 hours including naps, and almost half of the children were cosleeping in the same bed as their parents or siblings (Table 2). The sample had a mean total CSHQ sleep problems score of 45.7 (out of 97), with 72.3% exceeding the cutoff score of 41, indicating elevated sleep problems. On the Strengths and Difficulties Questionnaire (SDQ), participants reported a mean total SDQ emotional/behavioral difficulties (EBDs) score of 13.91 (out of 40), with 59.9% scoring above the cutoff score of 13 for clinically elevated EBDs. In this study, Cronbach's alpha values of the total CSHQ and SDQ score items were 0.76 and 0.73, respectively, indicating acceptable internal consistency for the use of the total scores.

Neurodevelopmental Disorder Diagnostic Subgroup Differences

Multivariate analyses of variance using Pillai's Trace examined child/demographic characteristics, screen use, sleep, and EBDs between the 3 neurodevelopmental disorder (NDD) diagnostic subgroups in the sample [autism spectrum disorder (ASD) (n = 145; 39.5%), speech and language disorders (SL) (n = 135; 36.7%), and "others" (n = 87; 23.7%) including global developmental delay, learning disorders, motor disorders, attention deficit/hyperactivity disorder, intellectual disability, and multiple NDD]. There was a significant difference, F (26,186) = 1.69 (p = 0.025; η^2 = 0.19; Table 1). Univariate tests showed group differences in Ages and Stages Questionnaires, Third Edition (ASQ-3) z-scores (ASQ-3-z) [F (2,104) = 13.61; p < 0.001; η^2 = 0.21; ASD subgroup had lower functioning than the other 2 groups] and age [F (2,104) = 4.32; p = 0.016; η^2 = 0.08; "Others" subgroup was older than ASD and SL participants] with large and medium effect sizes, respectively (Table 1). There were no significant group differences in screen use, sleep, or EBDs (η^2 = 0.002–0.055, all small effect sizes). Subsequent analyses therefore controlled for NDD diagnostic subgroup, ASQ-3-z, and age.

Table 2. Screen Use, Sleep, and EBDs by NDD Diagnostic Group

Measures	Valid Cases, n (%)	Total	ASD n = 145	SL n = 135	Others n = 87	Group Differences[a]
Screen use						
Child's average daily screen time, hr, mean (SD)						
Total	278 (75.7%)	3.98 (2.54)	3.97 (2.34)	3.86 (2.55)	4.16 (2.89)	F (2,104) = 0.59; p = 0.56; η^2 = 0.011
TV	336 (91.6%)	2.31 (1.78)	2.20 (1.69)	2.31 (1.78)	2.50 (1.93)	
Computer	294 (80.1%)	0.27 (0.72)	0.26 (0.77)	0.28 (0.67)	0.25 (0.68)	
Mobile	333 (90.7%)	1.58 (1.51)	1.67 (1.57)	1.55 (1.45)	1.48 (1.50)	
Video/handheld games	294 (80.1%)	0.06 (0.35)	0.02 (0.19)	0.03 (0.18)	0.15 (0.63)	
Average screen time >1 hr, n (%)	278 (75.7%)	261 (93.9%)	111 (93.3%)	87 (94.6%)	63 (94.0%)	
Parents' average daily screen time, hr, mean (SD)	353 (96.2%)	5.39 (3.79)	5.23 (3.57)	5.67 (4.04)	5.24 (3.77)	F (2,104) = 0.25; p = 0.78; η^2 = 0.005
Location of screen use, hrs, mean (SD)						
Home	349 (95.1%)	2.78 (2.17)	2.74 (1.95)	2.73 (2.26)	2.90 (2.40)	
Travel	314 (85.6%)	0.36 (0.73)	0.35 (0.74)	0.36 (0.62)	0.39 (0.88)	
Public	318 (86.6%)	0.51 (0.96)	0.57 (0.95)	0.42 (0.77)	0.53 (1.21)	
No. of screen devices, mean (SD)						
Total	366 (99.7%)	7.72 (3.59)	7.28 (3.24)	7.96 (4.09)	8.10 (3.26)	
Bedroom screen devices	220 (59.9%)	1.60 (1.87)	1.75 (1.90)	1.52 (1.95)	1.43 (1.71)	F (2,104) = 1.99, p = 0.14, η^2 = 0.037
Bedroom screen devices >1, n (%)	220 (59.9%)	127 (57.7%)	54 (58.7%)	45 (57.0%)	28 (57.1%)	
Use of screen devices within 1 hr of bedtime, n (%)	349 (95.1%)	195 (55.9%)	80 (58.0%)	67 (52.3%)	48 (57.8%)	
Age of first screen exposure, yr, mean (SD)	352 (95.9%)	1.74 (0.99)	1.49 (0.78)	1.75 (1.02)	2.13 (1.14)	F (2,104) = 3.03; p = 0.053; η^2 = 0.055
First screen exposure <18 mo, n (%)	352 (95.9%)	183 (52.0%)	83 (61.0%)	69 (52.3%)	31 (36.9%)	
Sleep						
Average daily sleep duration, hr, mean (SD)						
Total	295 (80.4%)	11.34 (1.07)	11.22 (1.16)	11.48 (0.96)	11.32 (1.07)	F (2,104) = 1.25; p = 0.29; η^2 = 0.023
Night (excludes nap)	342 (93.2%)	9.60 (0.81)	9.55 (0.87)	9.66 (0.74)	9.61 (0.82)	
Average sleep <10 hrs, n (%)	295 (80.4%)	29 (9.8%)	14 (11.8%)	8 (7.3%)	7 (10.6%)	
Sleep problems (CSHQ), mean (SD)						
Rates of clinically elevated sleep problems[b], n (%)	346 (94.3%)	250 (72.3%)	106 (79.1%)	81 (64.3%)	63 (73.3%)	
Total sleep problems score (CSHQ)	346 (94.3%)	45.72 (6.71)	45.90 (6.06)	45.18 (7.21)	46.24 (6.95)	F (2,104) = 0.11; p = 0.90; η^2 = 0.002
Cosleep with parents/siblings in the same bed, n (%)	361 (98.4%)	146 (40.4%)	61 (43.0%)	52 (39.1%)	33 (38.4%)	
EBD						
Rates of clinically elevanted EBD,[c] n (%)	339 (92.4%)	203 (59.9%)	93 (70.5%)	65 (51.6%)	45 (55.6%)	
Total EBD raw score (SDQ), mean (SD)	339 (92.4%)	13.91 (4.99)	15.16 (4.69)	12.72 (4.81)	13.71 (5.33)	F (2,104) = 0.90; p = 0.41; η^2 = 0.017

[a]Group differences were examined using multivariate analyses of variance. [b]Prevalence of sleep problems refer to CSHQ total scores above recommended cutoff of 41 (Owens, Spirito, & McGuinn, 2000). [c]Prevalence of EBD refers to SDQ total scores 13 and above (Goodman, 1997). ASD, autism spectrum disorder; CSHQ, Children's Sleep Habits Questionnaire; EBD, emotional/behavioral difficulties; Others, other neurodevelopmental disorders; SDQ, Strengths and Difficulties Questionnaire; SL, speech and language disorders.

Intercorrelations and Controlling for Confounding Variables

Significant associations were found between children's lower ASQ-3-z, younger age, lower family monthly income, and higher parental average daily screen time with increased children's screen use, poorer sleep quality, and more EBDs, with small to medium effect sizes (Table 3); hence, these variables were also controlled for in the main analyses.

Main Analyses

Relationship Between Screen Use, Sleep, and Emotional/Behavioral Difficulties

Adjusting for children's NDD diagnostic subgroup, ASQ-3-z, age, family income, and parents' average daily screen time, more bedroom screen devices and earlier age of first screen exposure, respectively, were both associated with poorer caregiver-reported sleep quality and higher EBDs total scores with small effect sizes

Table 3. Correlations Between Main Child/Demographic Characteristics, Screen Use, Sleep, and EBDs

Variable z	ASQ-3-z	Child's Age	Child's Gender	Parents' Marital Status	Family Income	Parents' Average Daily Screen Time
No. of bedroom devices						
r	−0.098	−0.120	0.039	0.041	**−0.250*****	0.053
p	0.196	0.076	0.568	0.547	<0.001	0.447
Age of first screen exposure						
r	0.014	**0.430*****	0.024	0.082	**−0.129***	0.027
p	0.814	<0.001	0.647	0.125	0.015	0.622
Child's average daily screen time						
r	**−0.182****	0.113	0.039	−0.016	**−0.240****	**0.293****
p	0.006	0.059	0.513	0.785	<0.001	<0.001
Average daily sleep duration						
r	0.016	**−0.301*****	0.090	0.025	−0.085	0.058
p	0.809	<0.001	0.123	0.672	0.144	0.326
Total sleep problems score (CSHQ)						
r	−0.063	−0.012	−0.036	−0.020	**−0.120***	0.074
p	0.294	0.826	0.506	0.713	0.025	0.176
Total EBD score (SDQ)						
r	**−0.243*****	0.012	**−0.112***	−0.022	−0.071	0.077
p	<0.001	0.832	0.039	0.681	0.192	0.164

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; values in **bold** are statistically significant correlations. CSHQ, Children's Sleep Habits Questionnaire; EBD, emotional/behavioral difficulties; SDQ, Strengths and Difficulties Questionnaire.

(Table 4). Average daily screen time was not associated with sleep quantity, sleep quality, or EBD and therefore was not examined further as a predictor in the subsequent mediation analyses (see also Discussion for more on data relating to duration of screen use obtained in this study). More EBDs were associated with reduced sleep quality and quantity with small effect sizes. There were no significant differences in analyses using the EBD subscales (externalizing vs internalizing factor subscale scores) as outcome variables, so the EBD total score analyses are reported here.

Exploring Sleep Problems as a Mediator Between Screen Use and Emotional/Behavioral Difficulties

Number of Bedroom Devices, Sleep Problems, and Emotional/Behavioral Difficulties

Adjusting for children's NDD diagnostic subgroup, ASQ-3-*z*, age, family income, and parents' average daily screen time, there was a full mediation effect (Fig. 1). The indirect effect of total CSHQ score was significant, with a small effect size (κ^2 = 0.080; *SE* = 0.037; 95% confidence interval [CI], 0.018–0.160). Approximately 13% of variance in total SDQ score was accounted for by the predictors examined (R^2 = 0.13; F (6,143) = 3.71; p = 0.002). The relationship between higher number of bedroom screen devices and more EBDs was fully explained by increased sleep problems in this sample.

Age of First Screen Exposure, Sleep Problems, and Emotional/Behavioral Difficulties

Adjusting for children's NDD diagnostic subgroup, ASQ-3-*z*, age, family income, and parents' average daily screen time, a full mediation effect was found (Fig. 2). The indirect effect of total CSHQ score was significant, with a small effect size (κ^2 = −0.055; SE = 0.024; 95% CI, −0.107 to −0.014). These results indicated that the relationship between children's age of first screen exposure and caregiver-reported EBDs was fully explained by sleep problems, with the model explaining a relatively small 10% of the variance in total SDQ scores (R^2 = 0.10; F (6,235) = 4.14; $p < 0.001$).

The same mediation analyses were performed separately by individual NDD diagnostic subgroups and also with EBD internalizing and externalizing subscales as the outcome variables. However, there were no significant findings.

Additional Analyses

Additional analyses explored differences between those who deviated from both AAP recommendations (having 1 or more bedroom screen device *and* age of first screen exposure under 18 months; n = 70) compared with those who adhered to 1 or both recommendations (no bedroom screen device *and/or* first screen exposure after 18 months; n = 147). Controlling for NDD diagnostic subgroup, ASQ-3-*z*, age, family income, and parents' average daily screen time, multivariate tests using Pillai's trace showed significant differences between the 2 groups, F(2,141) = 5.51 (p = 0.005; η^2 = 0.072) with a medium effect size. Further univariate tests found that those who deviated from both recommendations had higher total CSHQ sleep problem scores [F(1,142) = 8.64; p = 0.004; η^2 = 0.057] and more caregiver-reported EBD problems (higher SDQ scores; [F(1,142) = 6.05; p = 0.015; η^2 = 0.041]),

Table 4. Partial Correlations Between Screen Use, Sleep, and EBDs, Controlling for NDD Diagnostic Group, ASQ-3-*z*, Age, Family Income, and Parents' Daily Average Screen Time

Variable	No. Bedroom Screen Devices	Age First Screen Exposure	Average Daily Screen Time	Total EBD Score (SDQ)
Average daily sleep duration				
r	−0.089	0.083	0.005	**−0.137***
p	0.248	0.210	0.941	0.038
df	168	229	219	229
Total sleep problems score (CSHQ)				
r	**0.264****	**−0.155***	−0.037	**0.350*****
p	0.001	0.010	0.589	<0.001
df	168	271	219	265
Total EBD score (SDQ)				
r	**0.179***	**−0.157***	0.040	—
p	0.019	0.010	0.558	—
df	168	265	219	—

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; values in **bold** are statistically significant. ASD, autism spectrum disorder; ASQ-3-z, Ages and Stages Questionnaires, Third Edition, z-score; CSHQ, Children's Sleep Habits Questionnaire; EBD, emotional/behavioral difficulties; SDQ, Strengths and Difficulties Questionnaire.

compared with those who adhered to 1 or both recommendations, both differences being of small effect size.

DISCUSSION

To the authors' knowledge, the current study is one of the only few to explore the possible mediating role of sleep problems in the relationship between the number of bedroom devices, age of first screen exposure, and emotional/behavioral difficulties (EBDs) in preschool children with neurodevelopmental disorders (NDDs) presenting to a developmental pediatric clinic. At the same time, considering the elevated risk of sleep and EBDs in children with NDDs, even the small effect size relationships found may be clinically relevant for psychoeducation, prevention, and intervention efforts.

Patterns of Screen Use

The majority of children with NDDs in this study considerably exceeded American Academy of Pediatrics (AAP) recommended screen time limits of 1 hour per day, and more than half were first exposed to screens at the age of 18 months and younger and had at least 1 screen device in their bedrooms. Although this is comparable to the general Singaporean preschool population,[24,25] it is higher than reported international rates of screen use among preschool children and by children with NDDs in the United States.[1,12]

Consistent with the current literature, the present study also found a relationship between higher screen use and lower family income. This has been attributed to several factors, including parents having reduced alternative resources and limited knowledge of the potential impact of screen use,[23] and this higher screen use by preschoolers from lower-income families has also been associated with poorer self-regulatory behaviors.[30] The other inverse relationship between average daily screen time and Ages and Stages Questionnaires, Third Edition (ASQ-3)-*z* scores suggests that the use of screen devices may be accentuated among children with lower developmental functioning.[22]

Presence of Bedroom Screen Devices

The current study adds to the literature on children with NDDs by suggesting that bedroom screen devices may be associated with more EBDs indirectly through affecting children's sleep. One explanation is that children with NDDs may have more difficulty disengaging from screen devices compared with typically developing children; hence, the continued presence of these devices may signal possible reengagement and maintain elevated arousal, which interferes with sleep.[18]

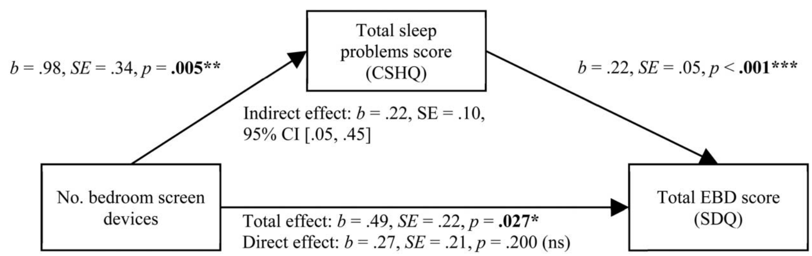

Figure 1. Regression coefficients of the relationship between the number of bedroom screen devices and EBD, mediated by sleep problems. Covariates controlled for are diagnostic group, ASQ-3-*z*, age, family income, and parents' average daily screen time. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; values in bold are statistically significant.

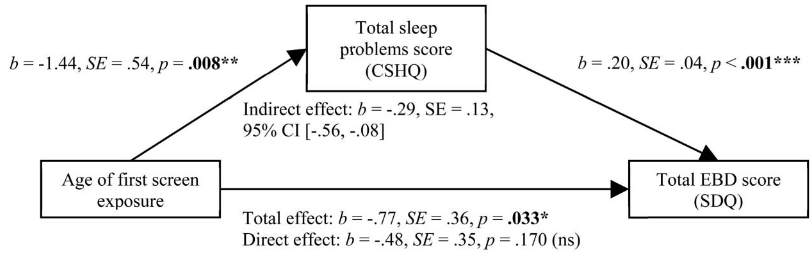

Figure 2. Regression coefficients of relationship between the age of first screen exposure and EBD, mediated by sleep problems. EBD, emotional/behavioral difficulties. Covariates controlled for are diagnostic group, ASQ-3-z, age, family income, and parents' average daily screen time. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; values in bold are statistically significant. ASQ-3-z, Ages and Stages Questionnaires, Third Edition, z-score; CSHQ, Children's Sleep Habits Questionnaire; EBD, emotional/behavioral difficulties; SDQ, Strengths and Difficulties Questionnaire; SE, standard error.

Another possibility is that children's sleep may be affected by lights and sounds emitted from incoming messages, e-mails, calls, and app notifications[31] because half have at least 1 mobile device in the bedroom where the child sleeps, and a substantial proportion cosleep with their parents or older siblings (a culturally common sleeping practice) who may engage with these devices. Supporting this, studies on adults found a high prevalence of engagement with or being woken up by mobile devices after lights out, which predicted poorer sleep quality, more fatigue, and higher insomnia.[32] Other possible explanations include light or electromagnetic emission from mobile devices altering sleep architecture and delayed melatonin production, which children with NDDs may be particularly vulnerable to.[17]

Age of First Screen Exposure

Earlier screen use has been posited to be associated with higher EBDs possibly because infants tend to have less mature self-regulation and may present with more self-regulatory problems than older children, increasing parental stress and thereby reliance on screen use.[9] The present study also suggests that earlier screen exposure may affect EBDs indirectly through affecting sleep. Given that children with NDDs are at a higher risk for sleep problems, earlier screen exposure may precipitate sleep problems sooner and cascade down a negative trajectory in emotional/behavioral development over time.[33] In particular, the present study found sleep problems but not daily sleep duration to mediate the relationship between age of first screen exposure and emotional/behavioral problems, suggesting that the qualitative disruption of sleep may be more important than the quantitative displacement of sleep.

Strengths and Limitations of the Present Study

Study strengths include the use of developmental functioning screening, sleep and EBD measures with good psychometric properties, the large sample size and high participation rates of invited participants, and diversity and representativeness of the sample recruited from Department of Child Development-KK Women's and Children's Hospital, which sees the largest number of children referred for developmental concerns in Singapore. This study also expands screen use operationalization by examining other screen variables besides screen time, such as bedroom screen devices and age of first screen exposure.

At the same time, the study's findings should be interpreted in light of its limitations. First, its cross-sectional design limits the ability to draw directional/causal connections between screen use, sleep, and EBDs. Other studies have suggested bidirectional relationships.[34] A longitudinal design will allow better interpretation of effects over time and impact on developmental trajectories, and hence a short-term follow-up study is currently underway. Second, the study relied on parent-reported measures, which may be subject to demand characteristics, reporting subjectivity or errors, and/or missing data. The measures used were screening tools, and there were no direct assessments of actual screen time, sleep duration, or behavior. The relatively large amount of missing data in the composite measures of screen time and sleep duration is largely likely due to ambiguous interpretation of the question item "*single* weekday/weekend" to denote 1 day (and not 5 days or 2 days, respectively); this may to some extent also explain the nonsignificant associations between screen time and EBDs, contrary to what other studies found.[18] Third, the ASQ-3 was designed as a screening tool for categorically identifying developmental delay, but for the study's purposes, raw scores were standardized to make a continuous scale for more fidelity in the degree of developmental delay. Ideally, a developmental assessment scale could be used, such as the Bayley Scales of Infant and Toddler Development (Bayley-III) or Vineland Adaptive Behavior Scales (Vineland-3), but this was not part of the clinic's routine administration and not feasible within the scope, timeframe, and resources of the present study. Although participants were diagnosed clinically by a multidisciplinary team using evidence-based clinical diagnostic methods and tools, these diagnoses were not additionally confirmed by the research team. Other factors, such as parental depression, were also not included.

Future Directions, Implications, and Recommendations

For Research

Future studies may utilize more objective measures such as electronic monitoring for screen use and actigraphy for sleep, corroborated with informant reports, although these studies may pragmatically be smaller in sample size.

The proposed mediation models explained 9% to 13% of variance in EBDs in children with NDDs. This points toward other possible variables being implicated in addition to the ones studied here. For example, parental depression may be implicated. Other possible mediating processes are also likely implicated, for example, screen use interfering with parent-child interactions or displacing social relationships,[35] which may consequently affect the child's emotional/behavioral functioning, and these would be important to investigate in future studies.

A recent study on parental mobile technology use highlighted that parents of young children experience conflicts within themselves about screen use for work or family purposes yet recognize that too much screen use can disrupt family routines and induce stress.[36] It may be useful to investigate how this internal conflict and stress experienced by parents around screen use may affect parent-child interactions and EBD in children.

For Policy and Practice

This study's cross-sectional findings in a multiethnic Asian sample of children with NDDs provide some support for AAP's recommendations to keep children's bedrooms free from screen devices, to encourage caregivers in cosleeping cultures to reduce and avoid screen use in bedtime routines and while their children are sleeping, and to discourage screen use before 18 months of age. This could pave the way for psychoeducation as part of routine pediatric clinic visits, parenting classes, school curriculum, and hospital- or government-endorsed policies regarding healthier screen use, particularly in groups at a higher risk for excessive screen use, such as in children with NDDs.

REFERENCES

1. Rideout V; VJR Consulting. *The Common Sense Census 2017: Media Use by Kids Age Zero to Eight*. New York: Common Sense Media Inc.; 2017.
2. American Academy of Pediatrics. AAP policy statement: media and young minds. *Pediatrics*. 2016;138:e20162591.
3. Rasmussen EE, Shafer A, Colwell MJ, et al. Relation between active mediation, exposure to Daniel Tiger's Neighborhood, and US preschoolers' social andemotional development. *J Child Media*. 2016;10:443–461.
4. Cespedes EM, Gillman MW, Kleinman K, et al. Television viewing, bedroom television, and sleep duration from infancy to mid-childhood. *Pediatrics*. 2014;133:e1163–71.
5. Vijakkhana N, Wilaisakditipakorn T, Ruedeekhajorn K, et al. Evening media exposure reduces night-time sleep. *Acta Paediatr*. 2015;104:306–312.
6. Schmidt ME, Rich M, Rifas-Shiman SL, et al. Television viewing in infancy and child cognition at 3 years of age in a US cohort. *Pediatrics*. 2009;123:e370–e375.
7. Mundy LK, Canterford L, Olds T, et al. The association between electronic media and emotional and behavioural problems in late childhood. *Acad Pediatr.* 2017;17:620–624.
8. Pagani LS, Fitzpatrick C, Barnett TA, et al. Prospective associations between early childhood television exposure and academic, psychosocial, and physical well-being by middle childhood. *Arch Pediatr Adolesc Med*. 2010;164:425–431.
9. Pempek TA, McDaniel BT. Young children's tablet use and associations with maternal well-being. *J Child Fam Stud*. 2016;25:2636–2647.
10. Radesky JS, Peacock-Chambers E, Zuckerman B, et al. Use of mobile technology to calm upset children: associations with social-emotional development. *JAMA Pediatr*. 2016;170:397–399.
11. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. Washington, DC: American Psychiatric Association; 2013.
12. Lo CB. *The Effects of Family and Social Engagement on the Screen Time of Youth with Developmental Disabilities: A Dissertation*. University of Massachusetts Medical School: GSBS Dissertations and Theses. 2013. Available at: http://escholarship.umassmed.edu/gsbs_diss/658. Accessed February 12, 2019.
13. Engelhardt CR, Mazurek MO, Sohl K. Media use and sleep among boys with autism spectrum disorder, ADHD, or typical development. *Pediatrics*. 2013;132:1081–1089.
14. Mazurek MO, Engelhardt CR, Hilgard J, et al. Bedtime electronic media use and sleep in children with autism spectrum disroder. *J Dev Behav Pediatr.* 2016;37:525–531.
15. Mazurek MO, Wenstrup C. Television, video game and social media use among children with ASD and typically developing siblings. *J Autism Dev Disord*. 2013;43:1258–1271.
16. Ayres KM, Mechling L, Sansosti FJ. The use of mobile technologies to assist with life skills/independence of students with moderate/severe intellectual disability and/or autism spectrum disorders: considerations for the future of school psychology. *Psychol Sch*. 2013;50:259–271.
17. Salti R, Tarquini R, Stagi S, et al. Age-dependent association of exposure to television screen with children's urinary melatonin excretion? *Neuroendocrinol Lett*. 2006;27:73–80.
18. Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: a review. *Sleep Med*. 2010;11:735–742.
19. Blunden SL. Behavioural sleep disorders across the developmental age span: an overview of causes, consequences and treatment modalities. *Psychology*. 2012;3:249–256.
20. Wolfe J, Kar K, Perry A, et al. Single night video-game use leads to sleep loss and attention deficits in older adolescents. *J Adolesc*. 2014;37:1003–1009.
21. Adams SK, Kisler TS. Sleep quality as a mediator between technology-related sleep quality, depression, and anxiety. *Cyberpsychol Behav Soc Netw*. 2013;16:25–30.
22. Radesky JS, Silverstein M, Zuckerman B, et al. Infant self-regulation and early childhood media exposure. *Pediatrics*. 2014;133:e1172–8.
23. Duch H, Fisher EM, Ensari I, et al. Screen time use in children under 3 years old: a systematic review of correlates. *Int J Behav Nutr Phys Act*. 2013;10:102.
24. Media Development Authority of Singapore. *Zero-to-Fourteen Consumer Experience Study 2014*. Singapore: Media Development Authority of Singapore; 2015.
25. Goh SN, Teh LH, Tay WR, et al. Sociodemographic, home environment and parental influences on total and device-specific screen viewing in children aged 2 years and below: an observational study.*BMJ Open*. 2016;6:e009113.
26. Squires J, Twombly MS, Bricker D, et al. *Ages and Stages Questionnaires*, 3rd ed. Brookes Publishing; 2009.
27. Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. *Sleep*. 2000;23:1043–1051.
28. Aishworiya R, Chan P, Kiing J, et al. Sleep behaviour in a sample of preschool children in Singapore. *Ann Acad Med Singap*. 2012;41:99–104.
29. Goodman R, Ford T, Simmons H, et al. Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *Int Rev Psychiatry*. 2003;15:166–172.
30. Munzer TG, Miller AL, Peterson KE, et al. Media exposure in low-income preschool-aged children is associated with multiple measures of self-regulatory behaviour. *J Dev Behav Pediatr*. 2018;39:303–309.

31. Garrison MM, Liekweg K, Christakis DA. Media use and child sleep: the impact of content, timing, and environment. *Pediatrics*. 2011;128:29–35.
32. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. *Soc Sci Med*. 2016;148:93–101.
33. Wiggs L, France K. Behavioural treatments for sleep problems in children and adolescents with physical illness, psychological problems or intellectual disabilities. *Sleep Med Rev*. 2000;4:299–314.
34. Magee CA, Lee JL, Vella SA. Bidirectional relationships between sleep duration and screen time in early childhood. *Pediatrics*. 2014;168:465–470.
35. MacMullin JA, Lunsky Y, Weiss JA. Plugged in: electronics use in youth and young adults with autism spectrum disorder. *Autism*. 2016;20:45–54.
36. Radesky JS, Kistin C, Eisenberg S, et al. Parent perspectives on their mobile technology use: the excitement and exhaustion of parenting while connected. *J Dev Behav Pediatr.* 2016;37:694–701.

Book Review

Ordinary Magic: Resilience in Development

Ann S. Masten. *Ordinary Magic: Resilience in Development*. The Guilford Press, New York, NY, 2015, 370 pp, paperback, $26.35.

In *Ordinary Magic*, Dr. Masten describes the history, progress, and current state of research on resilience in children and youth. Her target audience includes established and burgeoning resilience scholars, as well as professionals in related fields of science, education, medicine, and social science.

Dr. Masten begins part I with a conceptual overview by introducing the topic and defining terminology, reviewing the history of resilience science, and describing resilience models. In part II, she transitions to studies of individual resilience, including a longitudinal study assessing resilience in a community sample, research exploring resilience in homeless children, and studies of resilience during mass trauma, such as war, terrorism, and disasters. Part III segues to adaptive and protective systems in resilience. Dr. Masten first elucidates the protective factors that have been consistently identified across studies. She then summarizes the research on neurobiology of adaptive systems, including attachment, adaptive thinking and problem solving, executive function and self-regulation, stress regulation and coping, and reward systems. Dr. Masten moves on in the final chapters of part III to describe resilience in the context of families, schools, and culture.

Part IV is entitled "Moving Forward: Implications for Action and Future Research." In this section, Dr. Masten puts forth what she describes as "a resilience framework for action," which includes the following 5 components: mission, models, measures, methods, and multilevel/multidisciplinary approaches. She highlights each component, focusing on including strengths and positive aspects in models, tracking the positive outcomes, preventing risk/adversity, increasing resources, mobilizing adaptive systems, and involving multiple disciplines at multiple levels. In the final chapter of part IV, Dr. Masten summarizes the book and expands upon her key conclusions.

With only minor flaws, including a few scattered typos, this text successfully provides a comprehensive overview of resilience in child development. Emphasizing that resiliency is not a trait in itself and that it can vary over time and under different circumstances, Dr. Masten tackles the interesting idea that certain attributes are both protective of and threatening to resilience. For example, she describes more advanced cognitive skills as being both protective (by improving problem-solving abilities) and threatening (by increasing a person's awareness of danger, which can lead to increased stress). Readers with interest in child development will appreciate the developmental approach Dr. Masten takes in this book. She suggests that the timing of exposures to extreme stressors with respect to developmental levels of the child is critical and considerably affects the manifestation of resilience, particularly during "windows of opportunity for change."

One of the primary strengths of *Ordinary Magic* is the range of perspectives from which resilience is considered. In addition to resilience researchers, this book holds appeal for a variety of other professionals. Chapters are segmented by theme, allowing readers to choose the sections that are most applicable to their interests. Teachers or school administrators, for example, might find the chapter "Resilience in the Context of Schools" illuminating. Social workers or case managers who work with homeless children might gravitate toward the chapter on resilience in homeless children and youth. For those interested in health implications, she briefly touches on possible stress-related health consequences of resiliency in the final chapter, although she could have devoted more space to this topic and to her interpretation. The "Conclusions and Future Directions" chapter provides a succinct summary of the research and lessons learned for the general reader.

Dr. Masten does acknowledge limits of the field, including differing opinions among researchers on how to define and measure resilience. She concludes by emphasizing the importance of using the knowledge gained through resilience research to help promote resilience in children in a world in which there are growing concerns about economic, environmental, and health crises across many sectors. Her final note is positive, highlighting opportunities to foster resilience in young children that can then lead to better outcomes for generations to come. Overall, *Ordinary Magic* is informative, well considered in its breadth, and thought provoking.

Disclosure: The author declares no conflict of interest.

Hannah T. Perrin, MD
Division of Developmental-Behavioral Pediatrics, Department of Pediatrics, Stanford University School of Medicine, Palo Alto, CA

ACKNOWLEDGMENTS

Thanks to Dr. Lynne C. Huffman, MD, for reviewing and editing this book review.

