

# Sleep Through Toddlerhood: The Distinct Roles of Overall Media Use and Use of Media to Regulate Child Distress

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**ABSTRACT:** *Objective:* Excessive media exposure has been associated with various sleep disturbances in early childhood. However, previous research mostly addressed the overall amount of media use while neglecting the role of media use practices. The purpose of this study was to examine whether media use practices (specifically, maternal use of media to regulate child distress) and overall media use predict distinct aspects of children's sleep. We hypothesized that frequent maternal use of media to regulate child distress will predict difficulties in sleep regulation, whereas higher child screen time will predict lower sleep duration. *Methods:* One-hundred fifty-one mothers (predominantly from the United Kingdom) completed anonymous online questionnaires via the Prolific platform that assessed child sleep latency and duration, use of media to regulate child distress, overall child screen time, and demographic covariates at 2 time points: 22 months (T1) and 26 months (T2) of children's age. *Results:* Maternal use of media to regulate child distress at T1 (but not screen time) predicted longer sleep latency at T2. Conversely, screen time (but not media to regulate distress) at T1 predicted shorter sleep duration at T2. These results were obtained while controlling for multiple covariates and sleep and media use at both time points. *Conclusion:* Findings suggest that media use practices and overall use have differential effects on sleep. Specifically, the use of media-based regulation strategies may interfere with the development of children's ability to self-soothe and regulate arousal in contexts that require the use of regulatory skills, such as transition to sleep.

(*J Dev Behav Pediatr* 00:1–8, 2020) **Index terms:** media use practices, screen time, sleep duration, sleep latency, toddlerhood.

**H**heavy consumption of screen media in early childhood has been associated with sleep disturbances, including short nighttime sleep duration, long daily naps, poor sleep quality, and long sleep latency.<sup>1,2</sup> However, previous research has mainly focused on the implications of the *amount* of exposure to media for children's sleep while neglecting the role of *media use practices* (i.e., the context and manner that media is used in). With the advent of mobile devices, the use of digital media has rapidly pervaded the home environment, leading researchers to consider how media is used by all members of the household and whether these media practices have implications for early child development.<sup>3,4</sup> Given the paucity of research on the effects of media use practices on children's sleep, the main goal of the current study was to examine whether the use of media to regulate child distress, a commonly used parental regulatory practice,<sup>5,6</sup> has unique implications for regulatory aspects of sleep (i.e., time taken to fall asleep) beyond overall media use. We also examined whether children's

overall media use was uniquely related to nighttime sleep duration.

Previous research has consistently shown that excessive screen media exposure during early childhood is related to disturbances in sleep quality and duration.<sup>7</sup> This body of research showed that greater consumption of screen media during infancy and toddlerhood was associated with shorter nighttime sleep duration, longer daily nap duration, poorer sleep quality, and longer sleep latency.<sup>1,2,7</sup> Other studies have pinpointed more specific aspects of media exposure that may negatively associate with sleep, such as content (e.g., violent or adult-oriented content),<sup>8</sup> timing of media use in a child's day (e.g., evening media use),<sup>9</sup> and access to screen media (e.g., screen media devices in a child's bedroom).<sup>10</sup> Less attention has been dedicated to understanding how media use practices can affect children's sleep behavior. In the current study, we aimed to expand this line of research by examining how the use of media to regulate child distress more broadly is related to children's sleep.

Several studies report that parents often use screens to soothe and calm children's distress.<sup>5,6,11</sup> Frequent use of this strategy may interfere with the development of children's self-regulation abilities in different contexts. During infancy and toddlerhood, self-regulation abilities are limited, and children are largely dependent on external regulation provided by their parents in modulating their emotions and arousal.<sup>12</sup> Through this process,

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children gradually learn emotional problem-solving strategies that help them establish independent self-soothing abilities.<sup>12</sup> The use of media to soothe negative emotions may establish media-dependent and distractive regulation strategies in young children, possibly leading to maladaptive coping in different contexts that require self-soothing such as sleep.

Sleep is considered a bioregulatory process that requires the ability to gradually reduce arousal.<sup>13</sup> Accordingly, an important aspect of sleep is sleep regulation, often referred to as the child's ability to transition independently between wake and sleep states through self-soothing practices.<sup>14</sup> Sleep problems in infancy serve as an indicator of early regulatory problems, and children who struggle to regulate their emotion are also likely to find it difficult to soothe themselves during bedtime and reduce their arousal before falling asleep.<sup>15</sup> Therefore, we propose that parental use of media as a child regulatory strategy may particularly affect the regulatory component of sleep, as measured by latency to fall asleep.

Given the important role of family media ecology in child development and the recent call to expand the examination of media effects beyond screen time,<sup>3</sup> the aim of the current study was to examine whether media use practices and overall media use predict distinct aspects of children's sleep. To consider the potential bidirectional links between different aspects of media use and sleep,<sup>16</sup> we used a repeated measures design in which media use and sleep were examined at 2 time points: 22 months (T1) and 26 months (T2) of children's age. Although this study is correlational in nature, the repeated measures design can enable a better understanding of the associations between media use practices, overall media use, and sleep overtime.

We proposed the following hypotheses:

1. H1: More frequent maternal use of media to regulate child distress at T1 will predict difficulties in sleep regulation (i.e., longer sleep latency) at T2.
2. H2: Longer child overall screen time at T1 will predict shorter nighttime sleep duration at T2.

We specifically focused on the toddlerhood period for 2 main reasons. First, recent census data indicate that the average screen time for children between the ages 2 and 4 years is approximately 2:40 hours a day,<sup>17</sup> far exceeding the recommendations of the American Academy of Pediatrics.<sup>18</sup> Accordingly, there is a growing concern about the long-term negative impact that prolonged screen exposure may have on a plethora of developmental outcomes, including sleep. Second, the toddlerhood period coincides with the emergence of self-regulatory abilities and may thus be a period in which children are particularly susceptible to environmental experiences that support or hinder their emerging regulatory skills.<sup>12,19</sup>

Data for the current study were collected through Prolific, an established platform for online subject

recruitment that was explicitly designed to recruit subjects for academic research.<sup>20</sup> The sample for the current study consisted predominantly of European white mothers residing in the United Kingdom.

## METHODS

### Participants and Procedure

The study protocol was reviewed and approved by the Human Subjects Research Committee at Ben-Gurion University of the Negev. Data were collected from January 2018 to January 2019 through Prolific.<sup>20</sup> Overall, the results from online experiments with subjects sampled from crowdworking platforms seem to offer high validity and reliability because researchers have successfully replicated well-known laboratory experiments using these platforms.<sup>20</sup> Data from crowdsourcing web samples were found to be as reliable as corresponding university samples and even more diverse in education and employment status.<sup>21</sup> However, these samples tend to have significantly higher computer and internet knowledge,<sup>21</sup> which may reduce generalizability to the general population. Prolific is an established platform for international online subject recruitment used by researchers from various fields,<sup>20</sup> including psychology.<sup>22</sup> A recent study concluded that Prolific is a valuable alternative to other crowdworking platforms because of its clarity about rights, obligations, and compensation of participants; the ability to prescreen participants based on prescreening questions; and the ability to conduct longitudinal studies by reapproaching participants from a specific study.<sup>20</sup>

Mothers of children between the ages 17 and 19 months were initially approached via Prolific and offered to participate in the study. Mothers who were willing to participate signed online consent forms. The initial sample consisted of 207 mothers predominantly from the United Kingdom. Because sleep variables were collected only in the 2 consecutive time points (ages 22 and 26 months), the current study focused only on these 2 time points. For this reason, we will refer to the 22-month time point as T1 and to the 26-month time point as T2. T1 consisted of 151 mothers (mean child age = 21.74, SD = 0.89; 61.6% male). Eleven participants were excluded from the analysis for the following reasons: child developmental problems ( $n = 2$ ), child respiratory problems ( $n = 5$ ), maternal adverse medical conditions ( $n = 3$ ), and inappropriate child age ( $n = 1$ ). In addition, participants who wrongly answered the attention-verifying items ("Not all participants read all the statements in studies. If you read this, please mark 4") at T1 ( $n = 5$ ) or T2 ( $n = 2$ ) were excluded from the analyses in that specific time point. Two of the participants who answered wrongly on the attention-verifying item at T1 did not complete T2 and therefore were excluded from the analysis at both time points. Thus, 138 participants comprised the final sample for the current study. Demographic information is reported in Table 1.

**Table 1.** Participants' Demographic Characteristics

	M	SD	Range
Maternal age (yr)	31.2	4.9	20–45
Child sex (%)			
Male	61.6%		
Female	38.4%		
Maternal education (%)			
Less than high school diploma	2.2%		
Full high school diploma	13%		
Some college (no degree)	27.5%		
Associate degree or vocational/technical training	11.6%		
Bachelor's degree	31.2%		
Graduate degree	14.5%		
Current country of residence (%)			
United Kingdom	80.4%		
United States	14.5%		
Other European country	4.9%		
Ethnicity (%)			
European white	92%		
African American	3.6%		
Asian	2.9%		
Other ethnicity	1.4%		
No. of children	1.89	0.96	1–6
Family status (%)			
In a relationship or married	86.9%		
Separated or divorced	4.3%		
Single	8.7%		
Employment status (%)			
Full-time employees	26.3%		
Part-time	42.9%		
Unemployed/stay-at-home mother	30.8%		

## Measures

### Sleep Latency and Duration

Sleep measures were assessed at both time points using the “Brief Screening Questionnaire for Infant Sleep Problems” (BISQs).<sup>23</sup> This measure has been validated against actigraphy and sleep diaries and has been established as a valid tool for assessing infant sleep problems.<sup>23</sup> The BISQ produces several sleep measures from which only 2 were used in the current study, as was done in previous studies.<sup>1</sup> These measures were obtained by asking mothers to report their child's (1) sleep latency: “How long does it typically take your child to fall asleep at night?” rated on a scale from 1 (less than 5 minutes) to 5 (more than 1 hour) and (2) nighttime sleep duration: “How much total time does your child spend sleeping during the night (between 7:00 PM and 8:00 AM)” rated on a time scale consisting of hours and minutes.

### Use of Media to Regulate Distress

Maternal use of media to regulate child distress was assessed at both time points using a version of the

“Coping with Toddlers' Negative Emotion Scale” (CTNES)<sup>24</sup> that was modified for the current study. The CTNES consists of 12 different scenarios in which children exhibit distress (e.g., parent prohibits an activity). Mothers are asked to rate the likelihood to respond in 7 different ways to children's distress (e.g., minimizing the child's distress, encouraging emotional expressiveness, punitive reactions) on a scale ranging from 1 (very unlikely) to 7 (very likely). In the current study, 4 distress scenarios were presented to mothers to reduce participant burden, and an additional strategy was added—the likelihood of responding with the provision of media to calm the child's distress (e.g., “If my child becomes angry because s/he is not allowed to have a snack when s/he wants it, I would offer to let my child play or watch something on my phone/tablet/computer/television [TV]”)—which was the scale used to compose the current variable. Higher scores indicate higher provision of media to regulate child distress ( $\alpha = 0.80$ , 0.80 for T1 and T2, respectively).

### Child Screen Time

Screen time was assessed at both time points using maternal report of average screen time (i.e., watching TV, watching videos on a handheld device, or playing games) during a typical weekday and weekend day. We created weighted average scores for total screen time across time (weekdays and weekends) and devices (TV, handheld device, and games).

### Covariates

Maternal education was controlled for based on previous studies linking child screen time to maternal education level.<sup>9</sup> Maternal education was rated on a scale from 1 (“less than a high school diploma”) to 6 (“graduate degree”). Maternal use of unsupportive and supportive regulation strategies was also controlled for to examine the unique role of use of media to regulate distress. The items on each scale of the CTNES were averaged to create the supportive (problem-focused, emotion-focused, and expressive encouragement;  $\alpha = 0.83$ ) and unsupportive (minimizing and punitive reaction;  $\alpha = 0.76$ ) subscales.<sup>24</sup> Because previous research suggested that excessive media use is more likely in toddlers with difficult temperaments,<sup>25</sup> we controlled for child negative emotionality (NE) to account for the possible effects of child temperamental characteristics on both media use and sleep behaviors. NE is a dispositional tendency to experience aversive emotional states, which serves as an indicator of emotional reactivity, and particularly frustration management. Child NE was assessed using the Frustration subscale from the Early Childhood Behavior Questionnaire—Short Form,<sup>26</sup> which reflects negative affect related to interruption of ongoing tasks or goal blocking. This subscale is composed of 6 items (e.g., “When s/he asked for something and you said ‘no,’ how often did your child have a temper tantrum?”) that were rated on a scale ranging from 1 (never) to 7 (always). Higher scores indicate higher levels of child NE ( $\alpha = 0.78$ ). Additional covariates such as

daycare attendance, the number of children in the family, and the number of people in the household were also documented and considered as potential covariates but were not included because of power considerations.

### Statistical Analyses

To test our hypotheses, we used path analysis, an extension of multiple regression that allows for the analysis of models that include several dependent variables. Two path models were estimated using the AMOS 23 software package, respectively testing our 2 hypotheses. Each model predicted different aspect of sleep (latency or duration) and included the autoregressive paths, independent variables (media to regulate distress or screen time), and study covariates (i.e., maternal education, unsupportive regulation strategies, supportive regulation strategies, and child NE). To evaluate the unique contribution of the independent variables to the models, model comparisons were made between the full models in which all the paths were free to vary and alternative models that constrained to 0 the paths between the independent variables (i.e., media to regulate distress or screen time) to the dependent variables (i.e., sleep latency or duration). A  $\chi^2$  difference test was conducted to assess the differences between the full and constrained models.

#### Missing Data

Of the 138 participants who composed the final sample for the current study, 29 participants did not participate in the T2 assessment. No significant differences were found between participants who completed only T1 and participants who completed both assessments regarding demographics, study variables, and covariates. Screen time and sleep duration data for participants who reported aberrantly high child screen time ( $+3$  SDs above the mean, T1:  $n = 1$ , T2:  $n = 2$ ) or ab-

errantly low child sleep duration lower than 3 hours per night (T1:  $n = 4$ , T2:  $n = 4$ ) were excluded from the analysis because of concerns regarding the reliability of these reports. In addition, 4% of the children ( $n = 6$ ) had missing sleep latency data at T1, 6% ( $n = 8$ ) had missing sleep duration data at T1, and 4% ( $n = 4$ ) had missing sleep duration data at T2. Regarding screen time, 4% ( $n = 5$ ) had missing data at T1, and 2% ( $n = 2$ ) had missing data at T2. Finally, 3% ( $n = 4$ ) had missing data on media to regulate distress at T1. Participants with missing data (of any kind) had higher mean scores of use of media to regulate child distress at T1 ( $t = 3.42$ ,  $p = 0.001$ ) and T2 ( $t = 2.67$ ,  $p = 0.009$ ) and higher unsupportive regulation mean score ( $t = 2.59$ ,  $p = 0.01$ ). To account for missing data, we used a full maximum likelihood (FIML) estimator for all analyses. Because FIML procedures allow for the use of all available data from each participant, the full sample of  $n = 138$  was retained in all primary analyses.

### RESULTS

Table 2 presents means, SDs, and correlations for the main study variables and covariates. Media to regulate distress at both times was positively correlated with sleep latency at T2, but not with sleep duration. Conversely, child screen time at T1 was negatively correlated with sleep duration at T2, but not with sleep latency at both time points. Sleep latency and sleep duration were intercorrelated over time and were negatively correlated within and between time points. Media to regulate distress and child screen time were positively correlated within and between time points. Finally, unsupportive regulation strategies were positively correlated with media to regulate child distress and child screen time and negatively correlated with child sleep duration.

**Table 2.** Unweighted Means, Standard Deviations, and Correlations Among All Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Sleep latency T1	—											
2. Sleep latency T2	0.44*	—										
3. Sleep duration T1	-0.33*	-0.20**	—									
4. Sleep duration T2	-0.24**	-0.22**	0.69*	—								
5. Media to regulate distress T1	0.11	0.22**	-0.03	-0.10	—							
6. Media to regulate distress T2	0.15	0.23**	-0.15	-0.10	0.65*	—						
7. Screen time T1	0.07	0.10	-0.03	-0.27*	0.33*	0.25*	—					
8. Screen time T2	0.08	0.05	-0.13	-0.18	0.39*	0.34*	0.66*	—				
9. Unsupportive regulation strategies T1	0.14	-0.00	-0.18**	-0.14	0.19**	0.09	0.17	0.23**	—			
10. Supportive regulation strategies T1	-0.04	0.01	-0.10	-0.07	-0.13	-0.7	-0.15	-0.18	-0.05	—		
11. Maternal education T1	-0.04	-0.00	0.17**	0.15	-0.21**	-0.11	-0.06	-0.22**	-0.13	0.11	—	
12. Child negative emotionality T1	0.22**	0.08	0.02	-0.01	0.15	0.09	0.06	0.12	0.24*	-0.12	-0.09	—
Mean	2.78	2.71	610.04	611.52	2.73	2.73	144.03	155.84	3.34	5.29	4.00	3.84
SD	0.99	1.02	94.25	85.67	1.36	1.36	98.79	91.73	1.18	0.82	1.37	1.17

\* $p < 0.01$ . \*\* $p < 0.05$ .

## Sleep Latency Model (H1)

Media to regulate distress at T1 significantly predicted sleep latency at T2 ( $\beta = 0.20$ ,  $SE = 0.07$ ,  $p = 0.033$ ) and screen time at T2 ( $\beta = 0.16$ ,  $SE = 4.99$ ,  $p = 0.031$ ). However, screen time at T1 did not significantly predict sleep latency at T2 ( $\beta = -0.01$ ,  $SE = 0.001$ ,  $p = 0.911$ ). Figure 1 presents the standardized path coefficients.

Model comparisons were made between the full model seen in Figure 1, with all paths free to vary, and an alternative model that constrained the path between media to regulate child distress at T1 and sleep latency at T2 to 0. The full model was found to be the better-fitting model,  $\chi^2_{diff}(1) = 4.23$ ,  $p = 0.04$ , indicating that the addition of the path between of media to regulate child distress at T1 and sleep latency at T2 significantly improved model fit.

## Sleep Duration Model (H2)

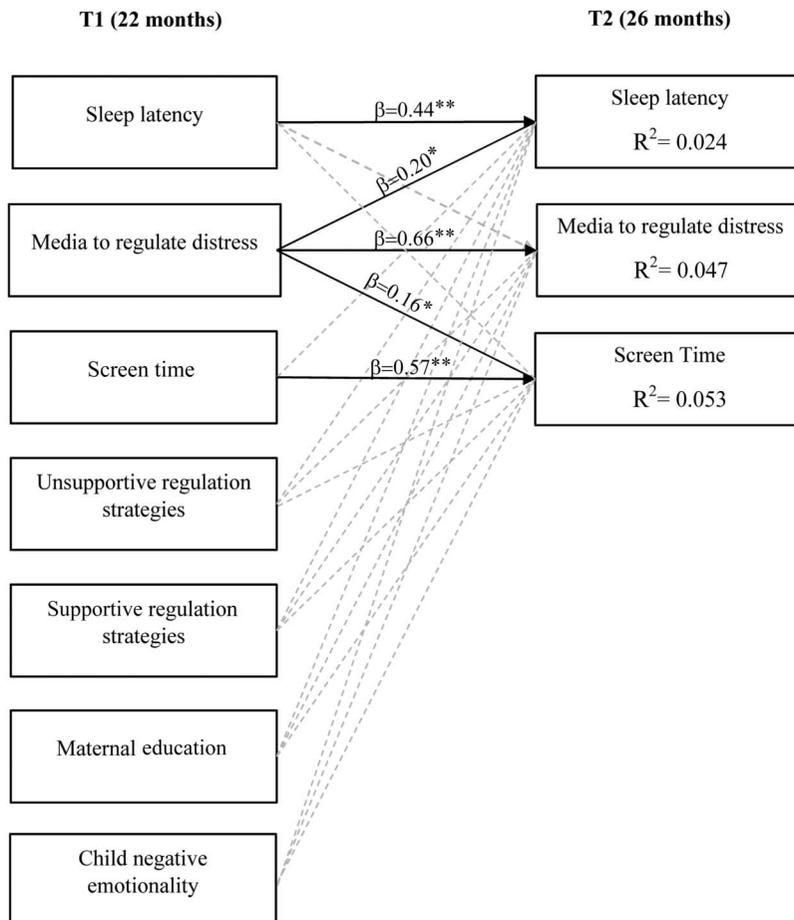
Screen time at T1 significantly predicted sleep duration at T2 ( $\beta = -0.19$ ,  $SE = 0.06$ ,  $p = 0.008$ ). However, media to regulate distress at T1 did not significantly predict sleep duration at T2 ( $\beta = 0.02$ ,  $SE = 4.65$ ,  $p = 0.771$ ). Figure 2 presents the standardized path coefficients.

Model comparisons were made between the full model seen in Figure 2, with all paths free to vary, and an alternative model that constrained the path between child screen time at T1 and sleep duration at T2 to 0. The full model was found to be the better-fitting model,  $\chi^2_{diff}(1) = 6.49$ ,  $p = 0.01$ , indicating that the addition of the path between child screen time at T1 and sleep duration at T2 significantly improved model fit.

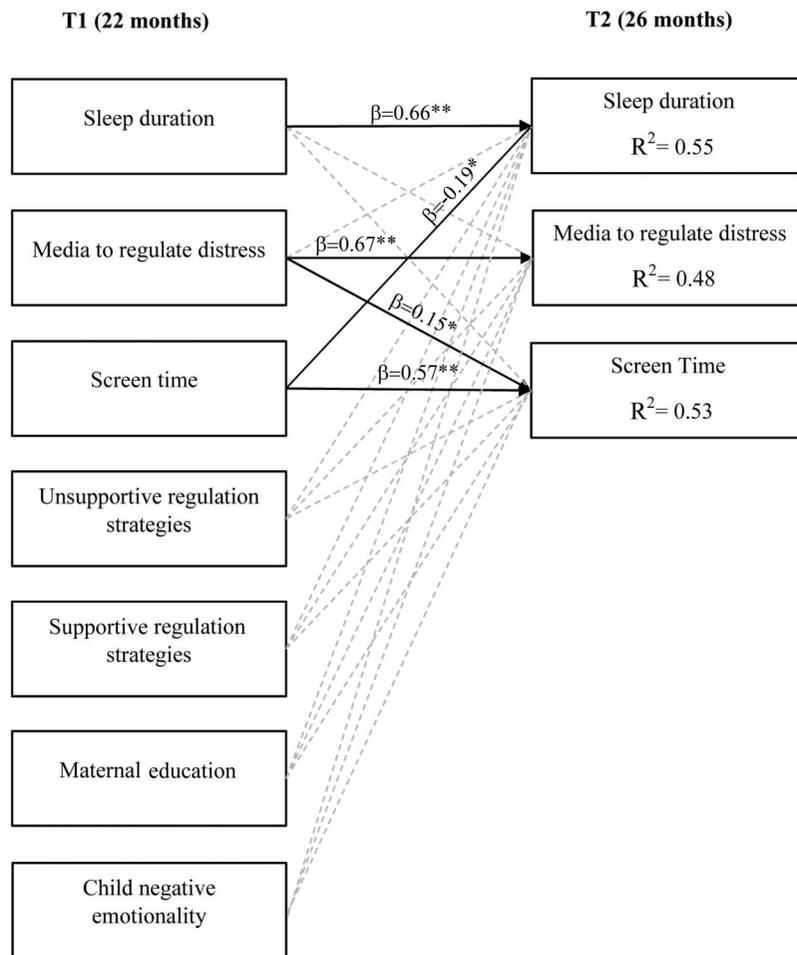
## DISCUSSION

The associations between toddlers' media consumption and sleep behaviors have been a focus of considerable research,<sup>1,2,7</sup> mostly addressing the overall *amount* of media use while neglecting the role of *media use practices*. The current study used a repeated measures longitudinal design to investigate the unique roles of the amount of media use versus media use practices in toddlers' sleep behaviors. Specifically, we focused on the practice of maternal use of media to regulate child distress.

To our knowledge, this is the first study to investigate the implications of maternal use of media to regulate child distress for children's sleep. The results show that different aspects of media use uniquely



**Figure 1.** A path model estimating autoregressive and crossed-lagged effects between child sleep latency and maternal use of media to regulate child distress and child screen time at T1 and T2. For ease of presentation, only significant paths are included in the figure; all concurrent associations within time points were estimated but are not presented; \* $p < 0.05$ . \*\* $p < 0.001$ .



**Figure 2.** A path model estimating autoregressive and crossed-lagged effects between child sleep duration and maternal use of media to regulate child distress and child screen time at T1 and T2. For ease of presentation, only significant paths are included in the figure; all concurrent associations within time points were estimated but are not presented; \* $p < 0.05$ . \*\* $p < 0.001$ .

associate with specific components of sleep. Consistent with our hypotheses, toddlers' longer screen time at the age of 22 months predicted shorter sleep duration at age 26 months, whereas maternal use of media to regulate child distress predicted the regulatory component of sleep (i.e., sleep latency). To examine the exclusiveness of the association between media regulation strategy and sleep, we included additional regulation strategies (supportive and unsupportive strategies)<sup>24</sup> in the analysis. Accordingly, we found that the media regulation strategy was the only strategy to predict sleep latency, suggesting that maternal use of media-based regulation strategies may interfere with the development of toddler's ability to self-soothe and regulate arousal in contexts that require the use of regulatory skills, such as bedtime.

Our findings are consistent with previous studies that reported an association between longer screen time and shorter sleep duration in toddlers.<sup>1,2</sup> Although previous findings rely on cross-sectional studies, our longitudinal study allowed us to test the bidirectionality of these associations. The findings show that screen time negatively predicted sleep duration beyond the concurrent correlations between these variables and their stability

across time. However, because of the correlational nature of the study, our findings cannot establish directional links between screen time and sleep duration. Several mechanisms have been proposed to explain the effect of media use on children's sleep. First, according to the displacement hypothesis, media use may directly displace time that would otherwise have been used for sleep, thus leading to a later bedtime and shorter sleep duration. Second, the exposure to blue light suppresses melatonin and consequently disrupts circadian rhythms.<sup>27</sup>

It is also possible that temperamental characteristics influence both sleep and media consumption.<sup>1,2</sup> Radesky et al.<sup>11</sup> suggested that children with self-regulation difficulties can be quite challenging, thus encouraging parents to use media to soothe their children, consequently leading to longer durations of screen time. To account for the possible effect of temperament on both sleep and media use, we controlled for child negative emotionality (a component of temperament). The results confirm that the associations between media use and sleep duration and the associations between media to regulate child distress and sleep latency were significant beyond the effect of temperament, providing

some initial support for the unique associations between media use and practices and children's sleep.

To the best of our knowledge, only 1 study has addressed the possible bidirectional relations between media use and sleep during childhood. In their study, Magee et al.<sup>16</sup> reported negative bidirectional links between sleep duration and media use at the ages 4 and 6 years. Contrary to these findings, our study found unidirectional paths between the use of media to regulate child distress/screen time at 22 months and sleep regulation/duration at 26 months, with the reverse associations being nonsignificant. These contradictory findings might be related to the age differences between the samples. Magee et al.<sup>16</sup> used a sample of 4- to 6-year-old children, who use media more independently, whereas in our sample (ages 22 and 26 months), media use is more determined by parents. It seems that for sleep duration to affect media use, some degree of independence in operating digital devices may be needed. Furthermore, Magee et al.<sup>16</sup> reported relatively small cross-lagged associations that may not have been detected in the current study because of a smaller sample.

Our findings should be considered in light of several limitations. First, because of the correlational nature of the study, causality cannot be inferred, and other intervening variables may explain the findings. Second, although the Prolific platform is considered to be a reliable and high-quality source of data, several limitations result from the use of an anonymous internet survey. As with other crowdworking platforms, Prolific cannot verify participant identities. Although we used attention-verifying questions throughout the survey, it is still not possible to verify all dishonest responses. Nevertheless, compared with other online participant recruitment platforms, Prolific participants have showed an equal or lower propensity to engage in dishonest behavior.<sup>28</sup> Another limitation that arises from the use of an online-recruited sample is that mothers may be biased in their attitudes toward media use. The decision to use this web platform may reflect positive attitudes toward media, reducing generalizability to the general population. Additional sample characteristics that may limit the generalizability of the findings include high education level, a large percentage of married mothers, and low ethnic and racial diversity. Future studies with more diverse samples are needed to understand how these findings apply to additional socioeconomic groups.

Finally, sleep and media measures were all collected through maternal reports, which are subjective and rely on maternal perspectives. Using objective measures of sleep (e.g., actigraphy) and media usage (e.g., passive sensing mobile apps) may reduce the bias created by maternal report.

Despite these limitations, this study has several strengths, including the repeated measures design that enabled investigation of the bidirectional links between different aspects of media use and sleep and the use of

the novel measure of maternal use of media to regulate child distress. This measure allowed us to investigate the implications of a new highly relevant form of parental regulation that has become more prevalent because of our media-saturated environment and changing family media ecology.<sup>3</sup> Together, our findings suggest that interventions are needed to raise parental awareness of the potential risks not only of media use but also media use practices for children's sleep behaviors. Reducing exposure to media and the use of media to regulate distress could reduce the rates of sleep difficulties among toddlers.

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