Infant Self-Regulation and Early Childhood Media Exposure

WHAT'S KNOWN ON THIS SUBJECT: Several studies suggest that excessive media use in early childhood predicts poorer developmental outcomes. It has not been studied whether infants with self-regulation problems, who may be at higher developmental risk, develop excessive media use habits.

WHAT THIS STUDY ADDS: This study shows that infants and toddlers with self-regulation difficulties (ie, problems with self-soothing, sleep, emotional regulation, and attention) view more media at 2 years of age, independent of other important confounders.

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abstract

OBJECTIVES: Examine prospective associations between parent-reported early childhood self-regulation problems and media exposure (television and video viewing) at 2 years. We hypothesized that children with poor self-regulation would consume more media, possibly as a parent coping strategy.

METHODS: We used data from 7450 children in the Early Childhood Longitudinal Study–Birth Cohort. When children were 9 months and 2 years old, parents completed the Infant Toddler Symptom Checklist (ITSC), a validated scale of self-regulation. With daily media use at 2 years as our outcome, we conducted weighted multivariable regression analyses, controlling for child, maternal, and household characteristics.

RESULTS: Children watched an average of 2.3 hours per day (SD 1.9) of media at age 2 years. Infants with poor self-regulation (9-month ITSC score ≥3) viewed 0.23 hour per day (95% confidence interval [CI] 0.12–0.35) more media at 2 years compared with those with 9-month ITSC score of 0 to 2; this remained significant in adjusted models (0.15 hour per day [95% CI 0.02–0.28]). Children rated as having persistent self-regulation problems (ITSC ≥3 at both 9 months and 2 years) were even more likely to consume media at age 2 (adjusted β 0.21 hour per day [95% CI 0.03–0.39]; adjusted odds ratio for >2 hours per day 1.40 [95% CI 1.14–1.71]). These associations were slightly stronger in low socioeconomic status and English-speaking households.

CONCLUSIONS: Early childhood self-regulation problems are associated with mildly increased media exposure, even after controlling for important confounding variables. Understanding this relationship may provide insight into helping parents reduce their children's screen time. *Pediatrics* 2014;133:e1172–e1178

Excessive media exposure in early childhood poses many developmental and behavioral health risks.[1] Exposure to television (TV) and videos before 3 years of age is associated with later problems with language development,[2–4] cognition,[5] attention,[6,7] executive functioning,[8] and school achievement.[9] These effects may be more pronounced in low-income populations, where high media exposure is more prevalent.[2] Proposed mechanisms for these detrimental effects include replacement of enriching activities with caregivers,[10] reduced language-based and play interactions with parents,[11–13] and less creative child play[14] while the TV is on.

Despite clear recommendations from the American Academy of Pediatrics (AAP) discouraging use of media in children younger than 2 years of age,[1] media use by infants and toddlers remains common.[15,16] Parental motivations to provide screen time during these years may stem from household or family characteristics (eg, single-parent household, maternal depression),[17] beliefs in the educational value of media,[18] and TV's ability to keep children occupied while parents get things done around the house.[17] Difficult behavior may also contribute to parents' decisions about how much screen time is appropriate for their child, although this relationship has been explored in only 1 cross-sectional study: Thompson and colleagues[19] found that low-income mothers who rated their infants as having a fussier temperament also reported higher TV viewing in the child's first year of life.

It is important to know whether infants and toddlers with behavioral regulation problems wind up watching more media, as this is a vulnerable population that is already at risk for adverse developmental outcomes.[20] Perhaps more importantly, child behavior could be an important residual confounder in the relationship between media and child development documented in the literature to date. If baseline child behavioral traits actually explain associations of high media exposure with later poor outcomes, our current understanding of the detrimental effects of media may have been the product of bias by indication.

We therefore aimed to examine prospective associations of infant and toddler behavioral self-regulation problems (ie, excessive fussing, poor self-soothing, difficulties with state changes, such as sleep) with daily media exposure (TV and video viewing) at 2 years by conducting a secondary analysis of the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B) study. We hypothesized that children with self-regulation problems would consume more media. Because media use practices and motivations vary among families from different backgrounds,[21] we also aimed to study whether these associations vary by family characteristics, such as socioeconomic status (SES), primary language, and race/ethnicity.

METHODS

Study Design and Participants

We conducted a retrospective cohort study by using data from the ECLS-B, a multisource, multimethod study that focuses on children's home and educational experiences from birth through kindergarten. Approximately 10 700 US children born in 2001 were followed through data collection visits at 9 months, 2 years, preschool, and kindergarten entry, at which times data were collected via interview, questionnaire, and structured developmental or physical assessments. The ECLS-B was conducted in English and Spanish and oversampled for racial/ethnic minorities, twins, and premature infants. We used data from the 9-month and 2-year time points, for which 99.7% and 97.8% of respondents

were the child's mother or female guardian. Further details about ECLS-B methods are available elsewhere.[22]

For this analysis, we excluded children with congenital diseases (eg, blindness, cleft lip and palate, spina bifida; $n = 50$), twins ($n = 1650$), or with developmental delay (Bayley Scales of Infant Development Mental [$n = 450$] or Motor score [$n = 400$] <1.5 SDs below the sample mean), as these children might have self-regulation problems that are significantly different from the general population. We additionally excluded all children without media outcome data ($n = 700$), leaving ~7450 children in the present analysis. Our sample was similar demographically to the ECLS-B study population (data not shown).

This study was deemed exempt from review by the Boston University Medical Center Institutional Review Board.

Child Self-Regulation

At the 9-month and 2-year assessments, caregivers completed the modified Infant Toddler Symptom Checklist (ITSC) (see Table 1), a validated scale for use in children 7 to 30 months of age.[23] Its purpose is to identify infants and toddlers with regulatory disorders who may be demanding of their caregivers; be unpredictably fussy; or have problems with sleep, feeding, or regulating mood and behavior. From the original 19 items of the ITSC, a modified 7-item list was created for use in the ECLS-B. These 7 items were chosen because they showed the largest mean difference between infants with and without regulatory disorders in the validation sample. According to ITSC scoring guidelines, we coded responses of "not at all" and "used to be" as 0, "sometimes" as 1, and "most of the time" as 2. Responses were summed to arrive at a total ITSC score; a higher score indicates greater self-regulation difficulties.

TABLE 1 Modified Infant Toddler Symptom
        Checklist Questions

9 months
  For each description, please tell me if CHILD is
      never like this, used to be like this, is like this
      sometimes, or is like this most times:
      Is frequently irritable or fussy
      Goes easily from a whimper to an intense cry
      Demands your attention and company
          constantly
      Wakes up 3 or more times in the night and is
          unable to go back to sleep
      Needs a lot of help to fall asleep (eg, rocking,
          long walks, stroking hair, car rides)
      Startles or is upset by loud sounds such as
          a vacuum, doorbell, or barking dog
      Is unable to wait for food or toys without
          crying or whining
2 years
  For each description, please tell me if CHILD is
      never like this, used to be like this, is like this
      sometimes, or is like this most times:
      Is frequently irritable or fussy
      Goes easily from a whimper to an intense cry
      In unable to wait for food or a toy without
          falling apart
      Is easily distractible, shows fleeting attention
      Needs a lot of help to fall asleep
      Tunes out from an activity and needs help to
          reengage
      Can't shift focus easily from one object or
          activity to another

Consistent with previous research by the test developers,[24] we dichotomized infants by a 9-month ITSC score of 0 to 2 (no or mild regulatory problems) versus $\geq$3 parent-endorsed symptoms (moderate to severe regulatory problems), as this threshold has predicted elevated risk of developmental and behavioral problems at 3 to 4 years of age.[25]

We also combined the 9-month and 2-year ITSC scores to capture evolution of self-regulation abilities over infancy and toddlerhood; we created a 4-category variable for children who had no/mild self-regulation problems (ITSC score 0–2 at both time points), improved (score $\geq$3 at 9 months and 0–2 at 2 years), worsened (score 0–2 at 9 months and $\geq$3 at 2 years), or had persistent self-regulation problems (score $\geq$3 at both time points). Children with no/mild self-regulation difficulties at both time

points represented the referent group in analyses.

Media Exposure

When their child was 2 years old, caregivers were asked to report how many hours their child spent watching TV and videos on a typical weekday and weekend day. We estimated each child's daily media hours by calculating a weighted average of the weekday and weekend hours and set this as our primary continuous outcome. We capped the maximum number of viewing hours per day at 16, as previous studies have done,[6] for the 8 parents who reported >16 hours per day. Although the continuous media variable was positively skewed, we determined that parametric methods could be used given the high number of participants in this analysis.[25]

We also examined media exposure as a dichotomous variable ($\leq$2 hours per day vs >2 hours per day) based on AAP media exposure guidelines.

Covariates

Parental and family characteristics were assessed via interview or questionnaire at 9 months and 2 years. We considered potential confounders in models if they had shown relationships with either child self-regulation or media exposure in published literature. These included characteristics on multiple levels of the child's biopsychosocial context: (1) child factors: race/ethnicity (white, black, Hispanic, and Asian/Pacific Islander/Alaska Native), age, gender, 9-month Bayley Mental and Motor scores, birth weight (normal, moderately low, or very low), parent-rated child health (fair/poor vs good/very good/excellent), and hours per week in child care; (2) parent factors: maternal age, paternal age, SES (an ECLS-B–derived variable that includes maternal and paternal education, employment status, and income),

maternal marital status (married, never married, separated/divorced/widowed), maternal general health (fair/poor versus good/very good/excellent), maternal depression (assessed by the Center for Epidemiologic Studies Depression Scale at 9 months and the World Mental Health Composite International Diagnostic Interview at 2 years), prenatal use of tobacco and alcohol (any vs none), and violence against the mother; (3) household factors: single-parent household, number of siblings (0, 1, 2, or 3+), language spoken at home (English vs non-English), neighborhood good for raising kids (excellent/very good, good, or fair/poor), household urbanicity (urban city, urban county, or rural), and modified Home Observation for Measurement of the Environment–Short Form (HOME-SF) score. The HOME-SF score was calculated based on observed interactions between the parent and child, as well as parent self-report of frequency of reading books, taking the child on errands, telling stories, and singing songs.

Data Analysis

In bivariate analyses, we used 2-way analysis of variance and χ^2 tests of association to examine relationships between exposures, outcomes, and potential confounders.

To examine associations between child self-regulation (independent variable) and media use (dependent variable), we built multivariable linear and logistic regression models weighted to account for the complex sampling design of the ECLS-B. We individually modeled the 9-month ITSC variable and combined 9-month + 2-year ITSC 4-category variable as categorical predictors. When data on covariates had been collected at both time points (eg, SES or household adults), we used covariates assessed at 9 months for the 9-month ITSC predictor variable, and

covariates assessed at 2 years for the combined 9-month + 2-year ITSC variable. After creating a full model containing all possible confounders, we performed backward elimination, removing variables whose exclusion from the model resulted in <10% change in the effect estimate for the predictor variable.

We further performed stratification of regression analyses by family SES (lower 3 vs higher 2 SES quintiles), household language, and child race/ethnicity.

RESULTS

Unweighted means and frequencies of sociodemographic characteristics of the study sample are shown in Table 2. The ECLS-B is a nationally representative sample, with weighted estimates of ~43% child minority race/ethnicity, 52% mothers completing high school or less, and 66% married mothers in our analysis sample. At 9 months, 2900 (39.2%) infants had moderate to severe self-regulation problems (ITSC score ≥3), whereas 1350 (18.1%) met this cutoff at both 9 months and 2 years (persistently poor self-regulation). Parents reported that their children watched a weighted mean (95% confidence interval [95% CI]) of 2.3 (2.2–2.3) hours of television and videos per day at 2 years, with 39.0% (weighted frequency) watching >2 hours per day.

Infants were more likely to be rated as having poor self-regulation if they were from a lower-income household; single-parent household; were of black race/ethnicity; or if the mother had lower educational attainment, endorsed poor/fair health, or met criteria for depression at 9 months (data not shown). More media exposure was reported in children of minority race/ethnicity, single-parent households, lower maternal educational attainment, or mothers with fair/poor health or depression (data not shown).

TABLE 2 Unweighted Sociodemographic Characteristics of 7450 Children and Mothers Included in the Present Analysis

	Study Sample (n = 7450), n (%)
Child male gender	3900 (51.1)
Child race/ethnicity	
White	3450 (46.3)
Black	1200 (15.9)
Hispanic	1550 (21.0)
Asian/Pacific Islander/Alaska Native	1250 (16.8)
Non-English primary language	1700 (22.9)
Child general health fair/poor	200 (2.7)
Maternal age <25	950 (12.6)
Maternal education	
Did not finish high school	1450 (19.5)
High school diploma or equivalent	2250 (30.5)
Some college or more	3750 (50.1)
Maternal marital status	
Married	4850 (65.4)
Never married	2100 (28.1)
Divorced/separated	500 (6.5)
Maternal employment status	
Full-time	2550 (34.3)
Part-time	1350 (18.0)
Seeking work	650 (8.7)
Not in labor force	2900 (39.0)
Maternal general health fair/poor	600 (8.1)
Maternal depression	3300 (50.2)
Prenatal tobacco exposure	900 (14.0)
Two-parent household	5850 (78.4)
Household income, $	
≤15 000	1450 (19.3)
15–30 000	1900 (25.2)
30–50 000	1600 (21.4)
50–100 000	1750 (23.6)
>100 000	800 (10.5)
Number of siblings in home	
0	3200 (43.1)
1	2500 (33.3)
2	1150 (15.4)
3 or more	600 (8.2)
Neighborhood good for raising kids	
Excellent/very good	4550 (61.3)
Good	1750 (23.9)
Fair/poor	1100 (14.8)
Moderate/severe regulatory problems at 9 mo	2900 (39.2)
Persistent moderate/severe regulatory problems and 9 mo and 2 y	1350 (18.1)
Excessive media use (>2 h/d) at 2 y	3000 (40.5)

Infants with moderate to severe self-regulation problems at 9 months or persistent difficulties with self-regulation at 9 months and 2 years watched significantly more daily hours of media, and were more likely to exceed 2 hours of media use per day at 2 years, compared with infants with no or mild problems (Table 3).

Table 4 shows crude and adjusted associations between child self-regulation categories and media use at 2 years.

After adjustment, infants with self-regulation problems watched 0.15 hour (95% CI 0.02–0.28) more media per day compared with infants with no/mild problems. Excessive media exposure (>2 hours per day) was more common in infants with self-regulation problems, but this relationship retained only borderline significance after adjusting for potential confounders (adjusted odds ratio [aOR] 1.16 [95% CI 0.997–1.36]). Toddlers with persistent self-regulation

TABLE 3 Mean Unweighted Daily Hours of Media Exposure and Rates of >2 Hours per Day of Media Use at 2 Years by ITSC Self-Regulation Category

Infant Toddler Symptom Checklist Category	Mean (SD) Hours of Media Use at 2 y	>2 h/d of Media Use at 2 y, (%)
9 mo		
No/mild self-regulation problems (ITSC 0–2)	2.2 (1.9)	38.4%
Moderate/severe self-regulation problems (ITSC ≥3)	2.5 (2.1)*	43.8%*
9 mo + 2 y		
No/mild self-regulation problems (ITSC <3 at 9 mo and 2 y)	2.2 (1.9)	36.7%
Improved (ITSC ≥3 at 9 mo and <3 at 2 y)	2.3 (1.9)	40.7%
Worsened (ITSC <3 at 9 mo and ≥3 at 2 y)	2.3 (1.8)	42.7%
Persistent problems (ITSC ≥3 at 9 mo and 2 y)	2.6 (2.2)*	47.5%*

* $P < .0001$.

TABLE 4 Adjusted Effect Estimates and Odds Ratios for Daily Mean Media Exposure and Viewing >2 Hours per Day at 2 Years by ITSC Self-Regulation Category

Infant Toddler Symptom Checklist Category	Average daily TV/Video Exposure, β (95% CI)	Watch >2 h/d, Odds Ratio (95% CI)
9 mo ITSC ≥3 (moderate/severe self-regulation problems) vs ITSC 0–2 (no/mild problems)		
Crude	0.23 (0.12–0.35)	1.27 (1.11–1.44)
Adjusted[a]	0.15 (0.02–0.28)	1.16 (0.997–1.36)
9 mo + 2 y combined ITSC		
No/mild self-regulation problems		
Crude	0 (reference)	1 (reference)
Adjusted[a]	0 (reference)	1 (reference)
Improved		
Crude	0.19 (0.04–0.35)	1.22 (1.00–1.48)
Adjusted[a]	0.12 (−0.05–0.28)	1.20 (0.97–1.49)
Worsened		
Crude	0.10 (−0.03–0.24)	1.31 (1.08–1.60)
Adjusted[a]	0.01 (−0.12–0.14)	1.27 (1.04–1.56)
Persistent self-regulation problems		
Crude	0.34 (0.17–0.50)	1.57 (1.31–1.87)
Adjusted[a]	0.21 (0.03–0.39)	1.40 (1.14–1.71)

[a] Adjusted model includes child race, age, overall health, maternal age, SES (education, employment, income), general health, non–English-speaking household, neighborhood safety, siblings at home, urbanicity, HOME-SF score.

difficulties watched even more media on a daily basis than their peers, even after adjustment for confounders: (0.21 hour per day [95% CI 0.03–0.39]; aOR for >2 hours per day 1.40 [1.14–1.71]). Toddlers whose self-regulation skills had worsened since infancy also were more likely to watch >2 hours per day (aOR 1.27 [1.04–1.56]), whereas those whose self-regulation had improved were not significantly more likely to watch >2 hours per day at age 2 after adjustment for confounders (Table 4).

As a post hoc analysis, we examined associations of self-regulatory problems with coviewing practices to assess whether parents were taking a break from their difficult children by putting them in front of the TV more often, rather than the recommended practice of watching media together.[26] In crude and adjusted models, self-regulatory problems at 9 months or persistent problems at 9 months and 2 years were not associated with any parental coviewing behaviors, such as watching TV with the child or talking to the child during TV viewing (data not shown).

When primary analyses were stratified by SES, odds ratios for excessive media exposure at 2 years (>2 hours per day) appeared slightly stronger in lower SES families (aOR 1.23 [95% CI 1.04–1.47]) than in high SES families (1.03 [0.80–1.32]), when using the 9-month ITSC predictor (P for interaction .33). In

English-speaking families, the association between 9-month ITSC score and media use also appeared stronger (aOR 1.21 [95% CI 1.03–1.43]) than in non–English-speaking families (0.95 [0.70–1.30]; P for interaction .15). Stratification by race/ethnicity did not yield consistent patterns of association (data not shown).

DISCUSSION

Infants and toddlers who have difficulties with self-soothing, falling and staying asleep, and modulating their emotional states can be very challenging to parent. This study is the first to show longitudinally that infants and toddlers with these self-regulation difficulties may be placed in front of media by their caregivers more often in early childhood, a time when the detrimental sequelae of excessive media exposure are more pronounced.[1] We found that infants with self-regulation problems watched 0.15 hour per day (roughly 9 minutes) more media at age 2. Although this may not seem clinically meaningful on an individual scale, mild excesses in media use in early childhood may predict a trajectory of increasingly excessive use through adolescence.[27] In addition, we demonstrated that persistently difficult toddlers are 40% more likely to develop problematic media habits at age 2, with more than 2 hours of their day in front of a screen.

Our results are consistent with 1 other study[20] showing that infants rated by their mothers as fussy were exposed to more TV. In that study, infant behaviors and media use were measured at the same time, so it is unknown whether media exposure is dysregulating to infants or whether parents are using TV to try to calm their fussy infants, who might quiet their vocalizations and movements when directing visual attention to a screen.[28] Our findings demonstrate

that, longitudinally, infants with regulatory problems do watch more TV and videos later in their toddler years. However, the relationship is probably not unidirectional; child self-regulation abilities and media habits likely influence each other through a transactional process whereby parents might try to soothe fussier infants through screen time, which reduces the amount of enriching parent-infant interactions and other developmental activities, exposes infants to potentially inappropriate content, and contributes to continued regulatory difficulties, which in turn predict greater media exposure, and so on. Parents also may be allowing more media use with the hope that educational programs could benefit children with behavioral problems. We did not find associations between child self-regulation and parents' reported coviewing behaviors, which suggests that parents are not using media to take a break from their difficult children more often.

In lower SES families, associations of difficult behavior with media use may be stronger because TV is an easy and safe activity for children when other developmental resources are not available, whereas in low English-proficiency households, the emphasis on English language learning from TV[29] may be more important in the formation of early media habits than child behavior.

Our findings have 2 important implications. First, residual confounding by child behavior in the existing literature on media use and child development is unlikely. We showed small but statistically significant associations of poor self-regulation with excessive media use; however, these effect sizes were small enough that it seems doubtful that child behavior is fully driving the frequently replicated associations of media exposure with adverse developmental outcomes.

Second, these results raise the question of whether media exposure in difficult young children could be reduced by providing parents with alternative coping strategies that could instead provide the behavioral scaffolding known to improve children's regulatory outcomes. Although temperament is often thought of as a static characteristic, recent research suggests that infant self-regulation and early childhood cognitive and behavioral self-regulation (ie, executive function) can be improved over time with sensitive, responsive parenting,[30,31] and that these characteristics are highly important for later school success and resilience.[32,33]

One of the strengths of our study is its use of the concept of self-regulation. Instead of the more traditional route of assessing temperament, the ITSC focuses on the infant's regulatory responses during daily interactions and caregiving activities. These behaviors, including fussing, sleep, and feeding difficulties, are easier for parents to recognize and bring to attention in primary care, where they may be opportunities for intervention. Other strengths of our analysis include its large nationally representative and diverse sample, as well as the rich availability of covariates for inclusion in multivariable models.

However, children's media environments are constantly changing, and limitations of this study include its lack of measures of background TV or mobile media, both highly prevalent in children's lives,[18,34] and reliance on parental report, which is subject to more bias than use of a media diary. Our categorical outcome (>2 hours per day) was relatively common in this cohort, so use of odds ratios, although valid, may overestimate the true rela-

tive risks associated with poor self-regulation abilities. In addition, the ECLS-B study did not measure media exposure at 9 months, when it is already common,[15] so we could not adjust for the baseline influence of media in our models. It is also possible that residual confounding by an unmeasured characteristic of families associated with both child behavior and media use accounted for our findings.

CONCLUSIONS

Early childhood is an important time in the formation of lifelong media habits[27] and may be a crucial window for intervention. Our study suggests that previous findings of the negative developmental effects of media were likely not explained solely by confounding by child behavior. However, our findings raise the question of whether helping parents manage their child's difficult behaviors may be a way to prevent the development of excessive media use habits. Anticipatory guidance in pediatric practice could focus on discussing with parents their motivations behind media choices and recommending a healthier media diet toward more prosocial/educational content. Future directions for research include reproduction of these results in different populations, as well as examining whether children with self-regulation problems are differentially susceptible to the developmental effects of excessive media use.

ACKNOWLEDGMENTS

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